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BAKER BOTTS LLP TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35.U.S.C. 371		EXPRESS MAIL LABEL No EF378764928US	DATE 1/15/02
		ATTORNEY'S DOCKET NO A34882-PCT-USA	
		U.S. APPLICATION NO 10/031196 t/b/1	
INTERNATIONAL APPLICATION NO PCT/DE00/02172	INTERNATIONAL FILING DATE July 4, 2000	PRIORITY DATE CLAIMED July 15, 1999	
TITLE OF INVENTION METHOD AND DEVICE FOR ROLLING A METAL STRIP BY MEANS OF A SKIN-PASS ROLLING STAND			
APPLICANT(S) FOR DO/EO/US HANS-JOACHIM-FELKL, JOACHIM GÖPEL, and ROBERT WINKLER			
<p>Applicant herewith submits to the United States Designated /Elected Office (DO/EO/US) the following items and other information:</p> <ol style="list-style-type: none"> <input checked="" type="checkbox"/> This is a FIRST submission of items concerning a filing under 35 U.S.C. 371. <input type="checkbox"/> This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U.S.C. 371. <input type="checkbox"/> This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(I). <input checked="" type="checkbox"/> A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date. <input checked="" type="checkbox"/> A copy of the International Application as filed (35 U.S.C. 371(c)(2)) <ol style="list-style-type: none"> <input type="checkbox"/> is transmitted herewith (required only if not transmitted by the International Bureau). <input checked="" type="checkbox"/> has been transmitted by the International Bureau. <input type="checkbox"/> is not required, as the application was filed in the United States Receiving Office (RO/US). <input checked="" type="checkbox"/> A translation of the International Application into English (35 U.S.C. 371(c)(2)). <input type="checkbox"/> A copy of the International Search Report (PCT/ISA/210) <ol style="list-style-type: none"> <input type="checkbox"/> are transmitted herewith (required only if not transmitted by the International Bureau). <input type="checkbox"/> have been transmitted by the International Bureau <input type="checkbox"/> have not been made; however, the time limit for making such amendments has NOT expired. <input type="checkbox"/> have not been made and will not be made. <input checked="" type="checkbox"/> A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)). <input type="checkbox"/> An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)). <input type="checkbox"/> A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)). <p>Items 11. to 16. below concern other document(s) or information included:</p> <ol style="list-style-type: none"> <input checked="" type="checkbox"/> A copy of the International Preliminary Examination Report (PCT/IPEA/409) <input type="checkbox"/> An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included. <input checked="" type="checkbox"/> A FIRST preliminary amendment. <input type="checkbox"/> A SECOND or SUBSEQUENT preliminary amendment. <input checked="" type="checkbox"/> A substitute specification. <input type="checkbox"/> A change of power of attorney and/or address letter. <input type="checkbox"/> Other items or information: <ol style="list-style-type: none"> <input checked="" type="checkbox"/> a copy of the International Search Report (PCT/ISA/210) <input checked="" type="checkbox"/> a copy of the International Preliminary Examination Report (PCT/IPEA/409) <p>Comparison document; English and German versions of application; cover page of PCT international application PCT/DE00/02172; informal drawings (Figs. 1-3); PCT/IPEA/416; PCT/ISA/220; IDS (two copies); PTO Form 1449; cited references; postcard; and check in the amount of \$740.00.</p>			

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 531 Rec'd PCT/P. 15 JAN 2002

INTERNATIONAL APPLICATION NO PCT/DE00/02172		INTERNATIONAL FILING DATE July 4, 2000		PRIORITY DATE CLAIMED July 15, 1999	
17. [] The following fees are submitted: Basic National Fee (37 CFR 1.492(a)(1)-(5): Neither international preliminary examination fee (37 CFR 1.482) Nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO (1.492(a)(3)) \$1,040 International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO (1.492(a)(5)) \$890.00 International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO (1.492(a)(2)) \$740.00 International preliminary examination fee paid to USPTO (37 CFR 1.482) but all claims did not satisfy provisions of PCT Article 33(1)-(4) (1.492(a)(1)) \$710.00 International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(1)-(4) \$100.00 ENTER APPROPRIATE BASIC FEE AMOUNT = \$ 740				CALCULATIONS <small>PTO USE ONLY</small>	
Surcharge of \$130.00 for furnishing the oath or declaration later than [] 20 [] 30 months from the earliest claimed priority date (37 C.F.R. 1.492(e)).				\$	
Claims	Number Filed	Number Extra	Rate	\$	
Total Claims	9 -20=	0	X \$ 18.00	\$ 0	
Independent Claims	1 -3=	0	X \$ 84.00	\$ 0	
Multiple dependent claim(s) (if applicable)			+ \$280.00	\$	
TOTAL OF ABOVE CALCULATIONS =				\$ 740	
Reduction by 1/2 for filing by small entity, if applicable.				\$	
SUBTOTAL =				\$ 740	
Processing fee of \$130.00 for furnishing the English translation later than [] 20 [] 30 months from the earliest claimed priority date (37 CFR 1.492(f)).				\$	
TOTAL NATIONAL FEE =				\$ 740	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). \$40.00 per property				\$	
TOTAL FEES ENCLOSED =				\$ 740	
				Amt. refunded	\$
				charged	\$
a. <input checked="" type="checkbox"/> A check in the amount of \$ 740.00 to cover the above fees is enclosed. b. [] Please charge our Deposit Account No. 02-4377 in amount of \$ to cover the above fees. A copy of this sheet is enclosed. c. <input checked="" type="checkbox"/> The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 02-4377. A copy of this sheet is enclosed. NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status. SEND ALL CORRESPONDENCE TO: Bradley B. Geist BAKER BOTTS L.L.P. 30 Rockefeller Plaza New York, New York 10112-4498 <div style="text-align: right;"> PTO Reg: 27,551 1/15/02 Date </div>					

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531 Rec'd PCT/E 15 JAN 2002

BAKER BOTTS LLP

Attorney Docket Number: A34882-PCT-USA

Title: METHOD AND DEVICE FOR ROLLING A METAL STRIP
BY MEANS OF A SKIN-PASS ROLLING STAND

Use Space Below for Additional Information:

10031196/031196

A34882-PCT-USA (071308.0287)

531 Rec'd PCT. 15 JAN 2002 PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s) : Felkl al.
Serial No. : To Be Assigned
Filed : Herewith
For : METHOD AND DEVICE FOR ROLLING A METAL STRIP
BY MEANS OF A SKIN-PASS ROLLING STAND
Examiner : To Be Assigned
Group Art Unit : To Be Assigned

Assistant Commissioner for Patents
Washington, DC 20231

PRELIMINARY AMENDMENT

Sir:

Kindly amend the above-identified application before examination as follows:

IN THE SPECIFICATION:

Please substitute the originally-filed specification with the Substitute Specification which is enclosed herewith. A comparison document showing the differences between the translation of the originally-filed specification and the enclosed Substitute Specification is also enclosed herewith.

IN THE CLAIMS:

Please amend original claims 1-9 as follows:

1. A method for rolling a metal strip in a skin-pass rolling stand for reducing the metal strip's thickness wherein the strip enters and exits the rolling stand at a determined velocity with the being under tension, comprising setting the velocity of the metal strip when it enters the skin-pass rolling stand and the velocity of the metal strip when it exits the skin-pass rolling stand independently of the tension in the metal strip.
2. The method according to claim 1, wherein the thickness of the metal strip is reduced by between about 0.1% and 5%.
3. The method according to claim 2, wherein the thickness of the metal strip is reduced by between about 0.1% and 1%.
4. The method according to claim 1, further comprising setting the velocity of the metal strip when it enters the skin-pass rolling stand and the velocity of the metal strip when it exits the skin-pass rolling stand by the ratio of a desired thickness of the metal strip when it exits the skin-pass rolling stand to the thickness of the metal strip when it enters the skin-pass rolling stand.
5. The method according to claim 1, further comprising controlling the setting of the strip entry velocity by a controller for controlling the setting of the strip exit velocity to which a set value for the respective velocities is fed to the controller, and further wherein the set value for the velocity of the metal strip when it enters the skin-

pass rolling stand and the set value for the velocity of the metal strip when it exits the skin-pass rolling stand are set as a ratio of the desired thickness of the metal strip when it exits the skin-pass rolling stand to the thickness of the metal strip when it enters the skin-pass rolling stand.

6. The method according to claim 5, further comprising correcting the set value for the velocity of the metal strip when it enters the skin-pass rolling stand as a function of a measured value for the velocity of the metal strip when it enters the skin-pass rolling stand and of a measured value for the velocity of the metal strip when it exits the skin-pass rolling stand.

7. The method according to claim 6, further comprising correcting the set value for the velocity of the metal strip when it enters the skin-pass rolling stand as a function of a temporal mean of measured values for the velocity of the metal strip when it enters the skin-pass rolling stand and of a temporal mean of measured values for the velocity of the metal strip when it exits the skin-pass rolling stand.

8. The method according to claim 1, further comprising setting a roll nip in the skin-pass rolling stand as a function of the tension in the metal strip upstream of the skin-pass rolling stand and as a function of the tension in the metal strip downstream of the skin-pass rolling stand.

9. A skin-pass rolling stand for use in rolling a metal strip in accordance with the method of claimed 1, comprising a means for setting the strip entry velocity

independently of the tension in the metal strip, and a means for setting the strip exit velocity independently of the tension in the metal strip.—

A "Version With Marked Changes Made" is submitted herewith.

IN THE DRAWINGS:

Please amend Figure 1 by deleting the reference "22" and substituting "14"; deleting " τ_w " and substituting " τ_i "; and deleting " $v^*(1-E)$ " and substituting " $v^*(1-e)$ ".

REMARKS

By this Preliminary Amendment, applicants amend originally-filed claims 1-9 to comply with the U.S. Patent and Trademark Office practice and standards. No new matter has been added to the application. Amendments to the claims do not address any issues of patentability, and the amended claims are provided to place the application in better condition for allowance.

Likewise, the amendments to the specification are provided to correct grammatical and syntactical errors in the originally filed application. No new matter has been introduced into the application.

The amendments to the "Claims" are reflected in the attached "Version With Marked Changes Made."

Favorable consideration on the merits is respectfully requested.

Respectfully submitted,

Dated: January 15, 2002

By: 

Bradley B. Geist
Reg. No. 27,551

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Version With Marked Changes Made

WE CLAIM:

1. A method for rolling a metal strip (1) ~~by means of~~ in a skin-pass rolling stand (7), ~~for reducing the metal strip's thickness of~~ wherein the metal strip (1) enters and exits the rolling stand at a determined velocity with the ~~being reduced by the rolling in the skin-pass rolling stand (7) under tension, characterized in that~~ comprising setting the velocity (v_i) of the metal strip (1) when it enters the skin-pass rolling stand (7) and the velocity (v_o) of the metal strip (1) when it exits the skin-pass rolling stand (7) ~~are set independently of the tension in the metal strip (1).~~
2. The method ~~as claimed in~~ according to claim 1, ~~characterized in that~~ wherein the thickness of the metal strip (1) ~~is reduced by between~~ about 0.1% and 5%.
3. The method ~~as claimed in~~ according to claim 2, ~~characterized in that~~ wherein the thickness of the metal strip (1) ~~is reduced by between~~ about 0.1% and 1%.
4. The method ~~as claimed in~~ according to claim 1, 2 or 3, ~~characterized in that~~ further comprising setting the velocity (v_i) of the metal strip (1) when it enters the skin-pass rolling stand (7) and the velocity (v_o) of the metal strip (1) when it exits the skin-pass rolling stand (7) ~~are set with~~ by the ratio $(1-E^*)$ of the ~~desired~~ desired thickness of the metal strip (1) when it exits the skin-pass rolling stand (7) to the thickness of the metal strip (1) when it enters the skin-pass rolling stand (7).
5. The method ~~as claimed in claim 1, 2, 3 or 4,~~ in claim 1, further comprising controlling the setting of the strip entry velocity by a controller for controlling the

setting of the strip exit velocity to which a means set value for setting the respective velocities is fed to the controller, and further wherein the set value for the velocity of the metal strip
entry when it enters the skin-pass rolling stand and the set value for the velocity is provided for
the purpose of setting metal strip when it exits the velocity (v_i) of the metal strip (1) when it enters
the skin-pass rolling stand (7), and a means for setting the strip exit velocity is provided for the
purpose of setting the velocity (v_o) of the metal strip (1) when it exits the skin-pass rolling stand
(7), and a controller (20) is provided for controlling the means for setting the strip entry velocity,
and a controller (21) is provided for controlling the means for setting the strip exit velocity, a set
value for the velocity (v_i) of the metal strip (1) when it enters the skin-pass rolling stand (7) being
fed to the controller (20) of the means for setting the strip entry velocity and a set value for the
velocity (v_o) of the metal strip (1) when it exits the skin-pass rolling stand (7) being fed to the
controller (21) of the means for setting the strip exit velocity, characterized in that the set value
($v^*(1-E^*)$) for the velocity (v_i) of the metal strip (1) when it enters the skin-pass rolling stand (7)
and the set value (v^*) for the velocity (v_o) of the metal strip (1) when it exits the skin-pass rolling
stand (7) are set at a ratio ($1-E^*$) of the desired thickness of the metal strip (1) when it exits
the skin-pass rolling stand (7) to the thickness of the metal strip (1) when it enters the skin-pass
rolling stand (7).

6. The method as claimed in claim 1, 2, 3, 4 or 5, characterized in
that further comprising correcting the set value ($v^*(1-E^*)$) for the velocity (v_i) of the metal strip
(1) when it enters the skin-pass rolling stand (7) is corrected as a function of a measured value
($v_{i,m}$) for the velocity (v_i) of the metal strip (1) when it enters the skin-pass rolling stand (7) and
of a measured value ($v_{o,m}$) for the velocity (v_o) of the metal strip (1) when it exits the skin-pass
rolling stand (7).

7. The method as ~~claimed in~~according to claim 1, 2, 3, 4, 5 or 6, characterized in ~~that~~further comprising correcting the set value ($v^*(1-E^*)$) for the velocity (v_i) of the metal strip (1) when it enters the skin-pass rolling stand (7) ~~is corrected~~ as a function of a temporal mean ($\bar{v}_{i,m}$) of measured values ($v_{i,m}$) for the velocity (v_i) of the metal strip (1) when it enters the skin-pass rolling stand (7) and of a temporal mean (of measured values for the velocity of the metal strip) of measured values ($v_{o,m}$) for the velocity (v_o) of the metal strip (1) ~~when it exits the skin-pass rolling stand (7).~~ of measured values ($v_{o,m}$) for the velocity (v_o) of the metal strip (1) when it exits the skin-pass rolling stand (7).

8. The method as ~~claimed in~~according to claim 1, 2, 3, 4, 5, 6 or 7, characterized in ~~that the~~further comprising setting a roll nip in the skin-pass rolling stand (7) ~~is set~~ as a function of the tension in the metal strip (1) upstream of the skin-pass rolling stand (7) and as a function of the tension in the metal strip (1) downstream of the skin-pass rolling stand (7).

9. A device skin-pass rolling stand for use in rolling a metal strip (1) using a skin-pass rolling stand (7) in accordance with the method ~~as of~~claimed in one of the preceding claims, the thickness of the metal strip (1) being reduced by the rolling in the skin-pass rolling stand (7), characterized in that the device for rolling the metal strip (1) ~~has~~comprising a means for setting the strip entry velocity, ~~for the purpose of setting the velocity (v_i) of the metal strip (1) when it enters the skin-pass rolling stand (7) independently of the tension in the metal strip (1), and a means for setting the strip exit velocity, for the purpose of setting the velocity (v_o) of the metal strip (1) when it exits the skin-pass rolling stand (7) independently of the tension in the metal strip (1).~~

3/PRTS

10031-10/031196

A34882-PCT-USA-071308.0287

531 Rec'd PCT/F. 15 JAN 2002

BAKER BOTTS L.L.P.
30 ROCKEFELLER PLAZA
NEW YORK, NEW YORK 10112

TO ALL WHOM IT MAY CONCERN:

Be it known that WE, HANS-JOACHIM-FELKL, JOACHIM GÖEPEL, and ROBERT WINKLER, citizens of Germany, Germany, and Austria, respectively, whose post office addresses are Dreifaltigkeitsweg 8, D-91301 Forchheim, Germany; Fichtenstrasse 18, D-91094 Langensendelbach, Germany; and Donato-Polli-Strasse 54, D-91056 Erlangen, Germany, respectively, have invented an improvement in:

METHOD AND DEVICE FOR ROLLING A METAL STRIP
BY MEANS OF A SKIN-PASS ROLLING STAND

of which the following is a

SUBSTITUTE SPECIFICATION

FIELD OF THE INVENTION

[0001] The invention relates to an improved a method and a device for rolling a metal strip by means of a skin-pass rolling stand, wherein the thickness of the metal strip is reduced by the rolling in the skin-pass rolling stand.

BACKGROUND OF THE INVENTION

[0002] The rolling of steel by means of a skin-pass rolling stand serves primarily to roll specific properties into the steel by means of a slight reduction in thickness. The following are particularly suited for skin-pass rolling: flat products produced from soft steels for cold-working in accordance with DIN EN 10130 and DIN EN 10131; hot-rolled

metal strip in accordance with DIN EN 10051; precursor material for electrolytic strip surface treatment (DIN 17163-electrolytically galvanized, cold-rolled strip and sheet); relatively high-strength steels and phosphorus-alloyed steels with and without bake-hardening affects in accordance with SEW 093 and SEW 094; soft microalloyed steels in accordance with SEW 095; galvanized strip in accordance with DIN EN 10142; electric sheet produced from unalloyed and alloyed steels; non-grain-oriented, non-final-annealed steel in accordance with DIN 46400 Parts 2 and 4; and cold-rolled broad strip made from stainless, heat-resistant steels in accordance with DIN 59381 and 59382. The skin-pass rolling of soft steels (steel strips) for cold-working is carried out with the aim of eliminating the pronounced yield point of the steel strip, improving the planarity of the steel, strip and setting a defined roughness of the strip surface.

SUMMARY OF THE INVENTION

[0003] It is an object of the present invention to improve the quality parameters of steels or steel strips, such as for example the yield strength, the planarity, or the roughness of the steel strip, by means of skin-pass rolling. This object is achieved by a method and/or device for rolling a metal strip in a skin-pass rolling stand whereby the velocity of the metal strip when it enters the skin-pass rolling stand and the velocity of the metal strip when it exits the skin-pass rolling stand are set independently of the tension in the metal strip. In this way, it is possible to set the desired reduction in thickness with a high degree of accuracy, which results in a high quality metal or steel strip. The method according to the present invention is so accurate that it is even possible to reduce the yield strength in a steel in which a significant reduction of the yield strength

is only possible when the thickness is reduced by an amount which lies within a very narrow range, for example between about 0.475% and 0.525%. Accordingly, the invention is advantageously used for metal strips the thickness of which is reduced by between about 0.1% and 5%, and preferably between about 0.1% and 1%.

[0004] In a preferred embodiment of the invention, the velocity of the metal strip when it enters the skin-pass rolling stand and the velocity of the metal strip when it exits the skin-pass rolling stand are set in accordance with the ratio of the desired thickness of the metal strip when it exits the skin-pass rolling stand to the thickness of the metal strip when it enters the skin-pass rolling stand. Since the reduction in thickness is usually given as the lengthening of the metal strip or the elongation ratio, the velocity of the metal strip when it enters the skin-pass rolling stand and the velocity of the metal strip when it exits the skin-pass rolling stand are set by the ratio of the length of the metal strip when it enters the skin-pass rolling stand to the desired length of the metal strip when it exits the skin-pass rolling stand.

[0005] In a further preferred embodiment of the present invention, a means is provided for setting the velocity of the metal strip when it enters the skin-pass rolling stand, and a means is provided for setting the velocity of the metal strip when it exits the skin-pass rolling stand. Controllers are also preferably provided for controlling the means for setting the strip entry velocity and strip exit velocity. A set value for the velocity of the metal strip when it enters the skin-pass rolling stand is fed to the controller of the means for setting the strip entry velocity and a set value for the velocity of the metal strip when it exits the skin-pass rolling stand is fed to the controller of the means

for setting the strip exit velocity. The set value for the velocity of the metal strip when it enters the skin-pass rolling stand and the set value for the velocity of the metal strip when it exits the skin-pass rolling stand are set as a ratio of the desired thickness of the metal strip when it exits the skin-pass rolling stand to the thickness of the metal strip when it enters the skin-pass rolling stand. The same effect is achieved by setting the set value for the velocity of the metal strip when it enters the skin-pass rolling stand and the set value for the velocity of the metal strip when it exits the skin-pass rolling stand as a ratio of the length of the metal strip when it enters the skin-pass rolling stand to the desired length of the metal strip when it exits the skin-pass rolling stand.

[0006] In another preferred embodiment of the present invention, the set value for the velocity of the metal strip when it enters the skin-pass rolling stand is corrected as a function of a measured value for the velocity of the metal strip when it enters the skin-pass rolling stand and of a measured value for the velocity of the metal strip when it exits the skin-pass rolling stand.

[0007] In yet a further preferred embodiment of the present invention, the set value for the velocity of the metal strip when it enters the skin-pass rolling stand is corrected as a function of a temporal mean of measured values for the velocity of the metal strip when it enters the skin-pass rolling stand and of a temporal mean of measured values for the velocity of the metal strip when it exits the skin-pass rolling stand.

[0008] In yet another preferred embodiment of the present invention, the roll nip in the skin-pass rolling stand is set as a function of the tension in the metal strip upstream

of the skin-pass rolling stand and as a function of the tension in the metal strip downstream of the skin-pass rolling stand.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] Further details of the present invention are described hereinbelow in connection with the drawings, in which:

FIGURE 1 illustrates a known control arrangement for a skin-pass rolling stand;

FIGURE 2 illustrates an exemplary embodiment of an improved control arrangement for a skin-pass rolling stand; and

FIGURE 3 illustrates a preferred embodiment of the improved control arrangement for a skin-pass rolling stand.

DETAILED DESCRIPTION OF THE INVENTION

[0010] FIGURE 1 shows a control arrangement for a skin-pass rolling stand 7 for the skin-pass rolling of a metal strip 1. The skin-pass rolling stand 7 has two working rollers 10 and 11 and two support rollers 8 and 9. The metal strip 1 passes through the skin-pass rolling stand 7 in the direction indicated by arrow 6. A means for setting the strip entry velocity, indicated by the rolls 2 and 3, is provided upstream of the skin-pass rolling stand 7. A means for setting the strip exit velocity, indicated by the rolls 4 and 5, is provided downstream of the skin-pass rolling stand 7. In FIGURE 1, the means for setting the strip entry velocity and the means for setting the strip exit velocity are designed as a bridle. However, they may also be designed as levelers, S-rolls or coilers. A velocity v_i is imposed on the metal strip 1 upstream of the skin-pass rolling stand 7 by means of the rolls 2 and 3. A velocity v_o is imposed on the metal strip 1 downstream of

the skin-pass rolling stand 7 by means of the rolls 4 and 5. To set the velocity v_o of the metal strip 1 downstream of the skin-pass rolling stand 7, a controller 21 is provided, to which a set value v^* is fed. The controller 21 controls the rolls 4 and 5 in such a manner that the velocity v_o of the metal strip 1 when it exits the skin-pass rolling stand 7 corresponds to a desired set velocity v^* .

[0011] Tension-measuring rolls 12 and 13, which measure the tension τ_i of the metal strip 1 upstream of the skin-pass rolling stand 7 and the tension τ_o in the metal strip 1 downstream of the skin-pass rolling stand 7, are provided upstream and downstream of the skin-pass rolling stand 7. The values τ_i and τ_o , together with their corresponding predetermined set values τ_i^* and τ_o^* and also a set value v_w for the velocity v_w of the skin-pass rolling stand 7, are input variables for a tension controller 14. The tension controller 14 controls the velocity v_w of the skin-pass rolling stand 7. In addition, the tension controller 14 emits a tension-dependent correction value k_τ .

[0012] In an exemplary embodiment of the invention, the tension-measuring rolls 12 and 13 have incremental sensors (not shown), which measure the rotation of the tension-measuring rolls 12 and 13. These measured values are used to form a strip-lengthening value e , to which the following relationship applies:

$$e = \frac{v_{o,m} - v_{i,m}}{v_{i,m}}$$

where $v_{o,m}$ is the velocity of the metal strip 1 downstream of the skin-pass rolling stand 7 measured by the incremental sensor of the tension-measuring roll 13, and $v_{i,m}$ is the velocity of the metal strip 1 upstream of the skin-pass rolling stand 7 measured by means

of the incremental sensor of the tension-measuring roll 12. A value $v^*(1-e)$, which has previously been added to the tension correction value k_t , is fed to the controller 20 as set value for the velocity.

[0013] FIGURE 1 further illustrates that the rolling force in the skin-pass rolling stand 7 may be set to a predetermined set value F_w by means of a controller 15. For the sake of simplicity, the feedback means for the controllers 15, 20 and 21 are not illustrated.

[0014] FIGURE 2 shows an exemplary embodiment of the invention, in which the velocity v_1 of the metal strip 1 when it enters the skin-pass rolling stand 7 is set independently of the tension in the metal strip 1. In a preferred embodiment of the invention, the velocity v_1 of the metal strip 1 when it enters the skin-pass rolling stand 7 is set to a set value $v^*(1-E^*)$. In this case, E^* is the set value for the elongation e of metal strip 1. Instead of the tension controller 14 as shown in FIGURE 1, a tension-monitoring means 22 is provided. The tension-monitoring means – which is advantageously designed as a tension controller with preceding dead band – emits an additional set value dF_w for the rolling force, instead of a tension-specific correction value k_t , when the strip tension reaches the limit of its regulating range. The rolling force in this case remains as constant as possible.

[0015] FIGURE 3 shows a preferred exemplary embodiment of the invention which has been supplemented with a thickness-correction controller 25. The thickness-correction controller 25 determines a correction value k_E which is fed to the controller 20 and by means of which, for example, the set value $v^*(1-E^*)$ is corrected.

[0016] The thickness controller 25 determines the correction value k_E in such a manner that the temporal mean \bar{e} of the strip-elongation value e corresponds to one of the set values of the thickness reduction E^* . The temporal mean \bar{e} of the strip-elongation value e is formed by means of the functional block 26 in accordance with

$$\bar{e} = \frac{\bar{v}_{o,m} - \bar{v}_{i,m}}{\bar{v}_{i,m}}$$

where $\bar{v}_{o,m}$ is the temporal mean of the value $v_{o,m}$, i.e. the temporal mean of the velocity of the metal strip 1 downstream of the skin-pass rolling stand 7 measured by the incremental sensor of the tension-measuring roll 13, and $\bar{v}_{i,m}$ is the temporal mean of the value $v_{i,m}$, i.e. the temporal mean of the velocity of the metal strip 1 upstream of the skin-pass rolling stand 7 measured by the incremental sensor of the tension-measuring roll 13. The devices for forming mean values 27 and 28 are provided for the purpose of forming $\bar{v}_{o,m}$ and $\bar{v}_{i,m}$.

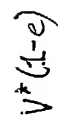
ABSTRACT OF THE DISCLOSURE

Method and device for rolling a metal strip by means of a skin-pass rolling stand (7), the thickness of the metal strip (1) being reduced by the rolling in the skin-pass rolling stand (7), and the velocity of the metal strip (1) when it enters the skin-pass rolling stand (7) and the velocity of the metal strip (1) when it exits the skin-pass rolling stand (7) being set independently of the tension in the metal strip (1).

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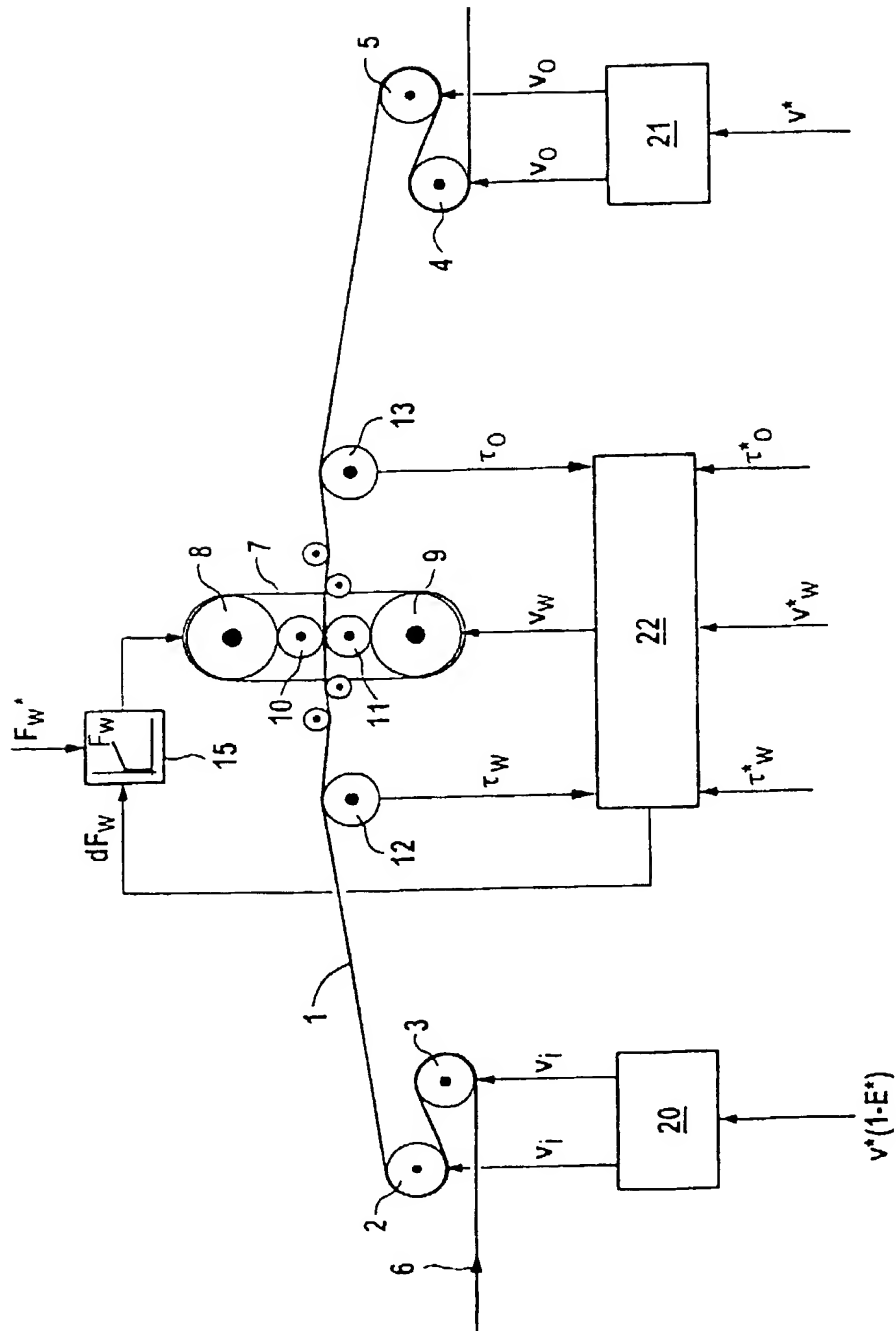
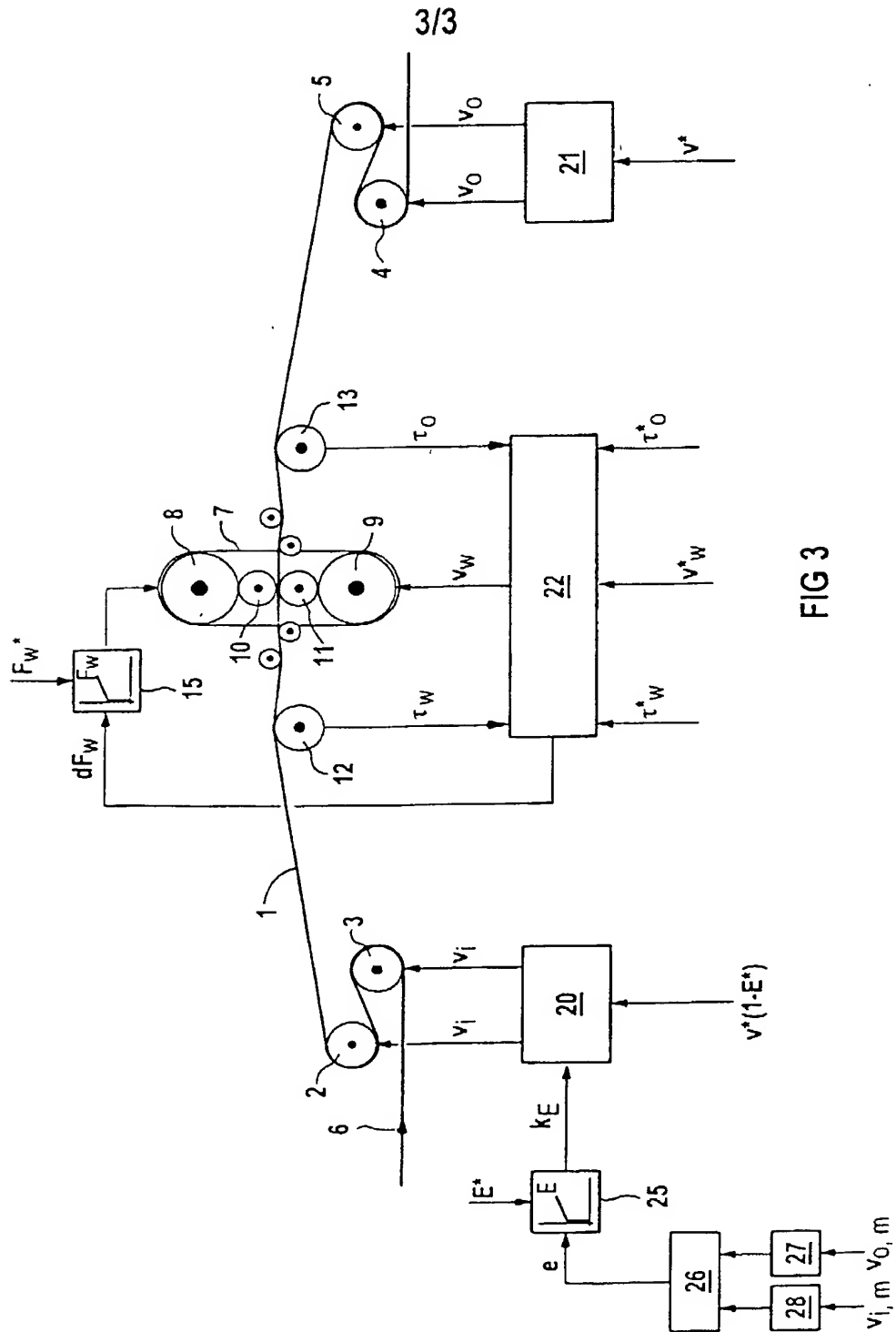


FIG 2



10031196 09624096
107031196

A34882-PCT-USA (071308.0287)

PATENT

531 Rec'd PCT/F.T.

15 JAN 2002

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NEW YORK, NEW YORK 10112

TO ALL WHOM IT MAY CONCERN:

Be it known that WE, HANS-JOACHIM-FELKL, JOACHIM GÖEPEL, and ROBERT WINKLER, citizens of Germany, Germany, and Austria, respectively, whose post office addresses are Dreifaltigkeitsweg 8, D-91301 Forchheim, Germany; Fichtenstrasse 18, D-91094 Langensendelbach, Germany; and Donato-Polli-Strasse 54, D-91056 Erlangen, Germany, respectively, have invented an improvement in:

METHOD AND DEVICE FOR ROLLING A METAL STRIP
BY MEANS OF A SKIN-PASS ROLLING STAND

of which the following is a

SPECIFICATION

FIELD OF THE INVENTION

[0001] ~~The invention relates to a method and a device for rolling a metal strip by means of a skin-pass rolling stand, the thickness of the metal strip being reduced by the rolling in the skin-pass rolling stand.~~ an improved a method and a device for rolling a metal strip by means of a skin-pass rolling stand, wherein the thickness of the metal strip is reduced by the rolling in the skin-pass rolling stand.

BACKGROUND OF THE INVENTION

[0002] ~~[0001]~~ ~~The invention relates to a method and a device for rolling a metal strip by means of a skin-pass rolling stand, the thickness of the metal strip being reduced~~

NY02:365637.1

COMPARISON

by the rolling in the skin-pass rolling stand. The skin-pass rolling of steel by means of a skin-pass rolling stand serves primarily to roll specific properties into the steel by means of a slight reduction in thickness. In particular, The following are particularly suited for skin-pass rolling: flat products produced from soft steels for cold-working in accordance with DIN EN 10130 and DIN EN 10131, 10131; hot-rolled metal strip in accordance with DIN EN 10051, 10051; precursor material for electrolytic strip surface treatment (DIN 17163-electrolytically galvanized, cold-rolled strip and sheet); relatively high-strength steels and phosphorus-alloyed steels with and without bake-hardening effects affects in accordance with SEW 093 and SEW 094, 094; soft microalloyed steels in accordance with SEW 095, 095; galvanized strip (in accordance with DIN EN 10142); electric sheet produced from unalloyed and alloyed steels; non-grain-oriented, non-final-annealed steel in accordance with DIN 46400 Parts 2 and 4; and cold-rolled broad strip made from stainless, heat-resistant steels in accordance with DIN 59381 and 59382 are suitable for the skin-pass rolling. 59382. The skin-pass rolling of soft steels (steel strips) for cold-working is carried out in particular with the aim of eliminating the pronounced yield point of the steel strip, improving the planarity of the steel strip and setting a defined roughness of the strip surface.

~~{0002}~~ The skin-pass rolling of soft steels (steel strips) for cold-working is carried out in particular with the aim of eliminating the pronounced yield point of the steel strip, improving the planarity of the steel strip and setting a defined roughness of the strip surface.

~~{0003} It is an object of the invention to further improve the quality parameters of steels or steel strips, such as for example the yield strength, the planarity or the roughness of the steel strip, by means of skin-pass rolling.~~

SUMMARY OF THE INVENTION

~~{0003}~~ {0004} According to the invention, ~~the~~ It is an object of the present invention to ~~It is an object of the invention to further improve the quality parameters of steels or steel strips, such as for example the yield strength, the planarity, or the roughness of the steel strip, by means of skin-pass rolling.~~ This object is achieved by means of a method and/or a device for rolling a metal strip by means of ~~in~~ a skin-pass rolling stand in accordance with claim 1 or claim 9, respectively. The thickness of the metal strip is reduced by rolling in the skin-pass rolling stand, whereby the velocity of the metal strip when it enters the skin-pass rolling stand and the velocity of the metal strip when it exits the skin-pass rolling stand ~~being~~ are set independently of the tension in the metal strip. In this way, it is possible to set the desired reduction in thickness particularly accurately, ~~so that metal or steel strip with a high degree of particularly accuracy, which results in a high quality is formed metal or steel strip.~~ This ~~The~~ method according to the present invention is so accurate that it is even possible to reduce the yield strength in a steel in which a significant reduction of the yield strength is only possible when the thickness is reduced by an amount which lies within a very narrow range, for example between about 0.475% and 0.525%. Accordingly, the invention is particularly advantageously used for metal strips ~~whose~~ the thickness of which is reduced by between about 0.1% and 5%, advantageously and preferably between about 0.1% and 1%.

NY02:365637.1

[0004] ~~{0005}~~ In an advantageous configuration a preferred embodiment of the invention, the velocity of the metal strip when it enters the skin-pass rolling stand and the velocity of the metal strip when it exits the skin-pass rolling stand are set in accordance with the ratio of the desired thickness of the metal strip when it exits the skin-pass rolling stand to the thickness of the metal strip when it enters the skin-pass rolling stand.

~~The~~ Since the reduction in thickness is usually given as the lengthening of the metal strip or the elongation ratio, i.e. ~~in an advantageous configuration of the invention~~ the velocity of the metal strip when it enters the skin-pass rolling stand and the velocity of the metal strip when it exits the skin-pass rolling stand are set ~~with~~ by the ratio of the length of the metal strip when it enters the skin-pass rolling stand to the desired length of the metal strip when it exits the skin-pass rolling stand.

[0005] ~~{0006}~~ In a further advantageous preferred configuration embodiment of the present invention, a means is provided for setting the velocity of the metal strip entry when it enters the skin-pass rolling stand, and a means is provided for setting the velocity ~~is provided for~~ of the purpose of setting metal strip when it exits the velocity of the metal strip when it enters the skin-pass rolling stand, and a means for setting the strip exit velocity is provided for the purpose of setting the velocity of the metal strip when it exits the skin-pass rolling stand, and a controller is provided for controlling the means for setting the strip entry velocity, and a controller is provided for controlling the means for setting the strip exit velocity, a set value for the velocity of the metal strip when it enters the skin-pass rolling stand being fed to the controller of the means for setting the strip entry velocity and a set value for the velocity of the metal strip when it exits the skin-pass rolling stand being fed to the controller of the means for setting the strip exit velocity,

NY02:365637.1

and in which the set value for the velocity of the metal strip when it enters the skin-pass rolling stand and the set value for the velocity of the metal strip when it exits the skin-pass rolling stand. Controllers are set at also preferably provided for controlling the means for setting the strip entry velocity and strip exit velocity. A set value for the velocity of the metal strip when it enters the skin-pass rolling stand is fed to the controller of the means for setting the strip entry velocity and a set value for the velocity of the metal strip when it exits the skin-pass rolling stand is fed to the controller of the means for setting the strip exit velocity. The set value for the velocity of the metal strip when it enters the skin-pass rolling stand and the set value for the velocity of the metal strip when it exits the skin-pass rolling stand are set as a ratio of the desired thickness of the metal strip when it exits the skin-pass rolling stand to the thickness of the metal strip when it enters the skin-pass rolling stand. The same effect is achieved by setting the set value for the velocity of the metal strip when it enters the skin-pass rolling stand and the set value for the velocity of the metal strip when it exits the skin-pass rolling stand with as the ratio of the length of the metal strip when it enters the skin-pass rolling stand to the desired length of the metal strip when it exits the skin-pass rolling stand.

[0006] In another preferred embodiment of the present invention, the set value for the velocity of the metal strip when it enters the skin-pass rolling stand is corrected as a function of a measured value for the velocity of the metal strip when it enters the skin-pass rolling stand and of a measured value for the velocity of the metal strip when it exits the skin-pass rolling stand.

~~[0007] In yet a further advantageous preferred configuration embodiment of the present invention, the set value for the velocity of the metal strip when it enters the skin-pass rolling stand is corrected as a function of a temporal mean of measured values for the velocity of the metal strip when it enters the skin-pass rolling stand and of a temporal mean of measured values for the velocity of the metal strip when it exits the skin-pass rolling stand.~~

~~[0008] In a further advantageous configuration of the invention, the set value for the velocity of the metal strip when it enters the skin-pass rolling stand is corrected as a function of a temporal mean of measured values for the velocity of the metal strip when it enters the skin-pass rolling stand and of a temporal mean of measured values for the velocity of the metal strip when it exits the skin-pass rolling stand.~~

~~[0008]~~ ~~[0009] In a particularly advantageous configuration of the~~In yet another preferred embodiment of the present invention, the roll nip in the skin-pass rolling stand is set as a function of the tension in the metal strip upstream of the skin-pass rolling stand and as a function of the tension in the metal strip downstream of the skin-pass rolling stand.

BRIEF DESCRIPTION OF THE DRAWINGS

~~[0009]~~ ~~[0010] Further advantages and inventive details will emerge from the following description of exemplary embodiments. In the drawing present invention are described hereinbelow in connection with the drawings, in which:~~

FIG. FIGURE 1 showsillustrates a known control arrangement for a skin-pass rolling stand;
NY02:365637.1

COMPARISON

~~FIG. FIGURE 2 shows~~illustrates an exemplary embodiment of an ~~inventiveimproved~~ control arrangement for a skin-pass rolling stand; and

~~FIG. 3 shows~~FIGURE 3 illustrates a ~~particularly advantageous~~ exemplarypreferred embodiment ~~for aof the improved~~ control arrangement for a skin-pass rolling stand.

DETAILED DESCRIPTION OF THE INVENTION

[0010] ~~{0011}~~ ~~FIG. FIGURE 1 shows a known~~ control arrangement for a skin-pass rolling stand 7 for the skin-pass rolling of a metal strip 1. The skin-pass rolling stand 7 has two working rollers 10 and 11 and two support rollers 8 and 9. The metal strip 1 passes through the skin-pass rolling stand 7 in the direction indicated by arrow 6. A means for setting the strip entry velocity, indicated by the rolls 2 and 3, is provided upstream of the skin-pass rolling stand 7. A means for setting the strip exit velocity, indicated by the rolls 4 and 5, is provided downstream of the skin-pass rolling stand 7. In ~~the present exemplary embodiment,~~FIGURE 1, the means for setting the strip entry velocity and the means for setting the strip exit velocity are designed as a bridle. However, they may also be designed as levelers, S-rolls or coilers. A velocity v_i is imposed on the metal strip 1 upstream of the skin-pass rolling stand 7 by means of the rolls 2 and 3. A velocity v_o is imposed on the metal strip 1 downstream of the skin-pass rolling stand 7 by means of the rolls 4 and 5. To set the velocity v_o of the metal strip 1 downstream of the skin-pass rolling stand 7, a controller 21 is provided, to which a set value v^* is fed. The controller 21 controls the rolls 4 and 5 in such a manner that the

velocity v_o of the metal strip 1 when it exits the skin-pass rolling stand 7 corresponds to a desired set velocity v^* .

[0011] ~~[0012]~~ Tension-measuring rolls 12 and 13, which measure the tension τ_i of the metal strip 1 upstream of the skin-pass rolling stand 7 and the tension τ_o in the metal strip 1 downstream of the skin-pass rolling stand 7, are provided upstream and downstream of the skin-pass rolling stand 7. The values τ_i and τ_o , together with their corresponding predetermined set values τ_i^* and τ_o^* and also a set value v_{wt} for the velocity v_w of the skin-pass rolling stand 7, are input variables for a tension controller 14. The tension controller 14 controls the velocity v_w of the skin-pass rolling stand 7. In addition, the tension controller 14 emits a tension-dependent correction value k_τ .

[0012] ~~[0013]~~ Moreover, in In an exemplary configuration embodiment of the invention, the tension-measuring rolls 12 and 13 have incremental sensors (not shown), which measure the rotation of the tension-measuring rolls 12 and 13. These measured values are used to form a strip-lengthening value e , to which the following relationship applies:

$$e = \frac{v_{o,m} - v_{i,m}}{v_{i,m}}$$

where $v_{o,m}$ is the velocity of the metal strip 1 downstream of the skin-pass rolling stand 7 measured by the incremental sensor of the tension-measuring roll 13, and $v_{i,m}$ is the velocity of the metal strip 1 upstream of the skin-pass rolling stand 7 measured by means of the incremental sensor of the tension-measuring roll 12. A value $v^*(1-e)$, which has

previously been added to the tension correction value k_t , is fed to the controller 20 as set value for the velocity.

[0013] ~~[0014]~~ Moreover, there is provision for FIGURE 1 further illustrates that the rolling force in the skin-pass rolling stand 7 ~~to~~may be set to a predetermined set value by means of a controller 15. ~~[0015]~~ For reasons F_w by means of a controller 15. For the sake of claritysimplicity, the feedback means for the controllers 15, 20 and 21 are not illustrated.

[0016] FIG. 2 shows an exemplary configuration of the invention, in which the velocity v_1 of the metal strip 1 when it enters the skin-pass rolling stand 7 is set independently of the tension in the metal strip 1. In a particularly advantageous configuration of the invention, the velocity v_1 of the metal strip 1 when it enters the skin-pass rolling stand 7 is set to a set value $v^*(1-E^*)$. In this case, E^* is the set value for the elongation e of metal strip 1.

[0014] ~~[0017]~~ FIGURE 2 shows an exemplary embodiment ~~FIG. 2 shows an exemplary configuration~~ of the invention, in which the velocity v_1 of the metal strip 1 when it enters the skin-pass rolling stand 7 is set independently of the tension in the metal strip 1. In a particularly advantageous configuration preferred embodiment of the invention, the velocity v_1 of the metal strip 1 when it enters the skin-pass rolling stand 7 is set to a set value $v^*(1-E^*)$. In this case, E^* is the set value for the elongation e of metal strip 1. Instead of the tension controller 14 as shown in FIG. FIGURE 1, a tension-monitoring means 22 is provided. The tension-monitoring means – which is advantageously designed as a tension controller with preceding dead band – emits an

NY02:365637.1

additional set value dF_w for the rolling force, instead of a tension-specific correction value k_t , when the strip tension reaches the limit of its regulating range. The rolling force in this case remains as constant as possible.

[0015] ~~{0018}~~ FIG. 3 shows an advantageous exemplary configuration of the invention. In this figure, the FIGURE 3 shows a preferred exemplary embodiment shown in FIG. 2 of the invention which has been supplemented with a thickness-correction controller 25. The thickness-correction controller 25 determines a correction value k_E which is fed to the controller 20 and by means of which, for example, the set value $v^*(1-E^*)$ is corrected.

[0016] ~~{0019}~~ The thickness controller 25 determines the correction value k_E in such a manner that the temporal mean \bar{e} of the strip-elongation value e corresponds to one of the set values of the thickness reduction E^* . The temporal mean \bar{e} of the strip-elongation value e is formed by means of the functional block 26 in accordance with

$$\bar{e} = \frac{\bar{v}_{o,m} - \bar{v}_{i,m}}{\bar{v}_{i,m}}$$

where $\bar{v}_{o,m}$ is the temporal mean of the value $v_{o,m}$, i.e. the temporal mean of the velocity of the metal strip 1 downstream of the skin-pass rolling stand 7 measured by the incremental sensor of the tension-measuring roll 13, and $\bar{v}_{i,m}$ is the temporal mean of the value $v_{i,m}$, i.e. the temporal mean of the velocity of the metal strip 1 upstream of the skin-pass rolling stand 7 measured by the incremental sensor of the tension-measuring roll 13.

The devices for forming mean values 27 and 28 are provided for the purpose of forming $\bar{v}_{o,m}$ and $\bar{v}_{i,m}$.

WE CLAIM:

1. A method for rolling a metal strip (1) ~~by means of~~ in a skin-pass rolling stand (7), ~~for reducing the metal strip's thickness of~~ wherein the metal strip (1) enters and exits the rolling stand at a determined velocity with the being reduced by the rolling in the skin-pass rolling stand (7) under tension, characterized in that comprising setting the velocity (v_i) of the metal strip (1) when it enters the skin-pass rolling stand (7) and the velocity (v_o) of the metal strip (1) when it exits the skin-pass rolling stand (7) are set independently of the tension in the metal strip (1).

2. The method ~~as claimed in~~ according to claim 1, characterized in that wherein the thickness of the metal strip (1) is reduced by between about 0.1% and 5%.

3. The method ~~as claimed in~~ according to claim 2, characterized in that wherein the thickness of the metal strip (1) is reduced by between about 0.1% and 1%.

4. The method ~~as claimed in~~ according to claim 1, 2 or 3, characterized in that further comprising setting the velocity (v_i) of the metal strip (1) when it enters the skin-pass rolling stand (7) and the velocity (v_o) of the metal strip (1) when it exits the skin-pass rolling stand (7) are set with by the ratio $(1-E^*)$ of the a desired thickness of the metal strip (1) when it exits the skin-pass rolling stand (7) to the thickness of the metal strip (1) when it enters the skin-pass rolling stand (7).

5. The method ~~as claimed in claim 1, 2, 3 or 4, in~~ according to claim 1, further comprising controlling the setting of the strip entry velocity by a controller for
NY02:365637.1

controlling the setting of the strip exit velocity to which a means~~set value~~ for setting the
respective velocities is fed to the controller, and further wherein the set value for the
velocity of the metal strip entry~~when it enters the skin-pass rolling stand and the set value~~
for the velocity is provided for~~of the purpose of setting~~metal strip when it exits the
velocity (v_i) of the metal strip (1) when it enters the skin-pass rolling stand (7), and a
means for setting the strip exit velocity is provided for the purpose of setting the velocity
(v_o) of the metal strip (1) when it exits the skin-pass rolling stand (7), and a controller
(20) is provided for controlling the means for setting the strip entry velocity, and a
controller (21) is provided for controlling the means for setting the strip exit velocity, a
set value for the velocity (v_i) of the metal strip (1) when it enters the skin-pass rolling
stand (7) being fed to the controller (20) of the means for setting the strip entry velocity
and a set value for the velocity (v_o) of the metal strip (1) when it exits the skin-pass
rolling stand (7) being fed to the controller (21) of the means for setting the strip exit
velocity, characterized in that the set value ($v^*(1-E^*)$ for the velocity (v_i) of the metal
strip (1) when it enters the skin-pass rolling stand (7) and the set value (v^*) for the
velocity (v_o) of the metal strip (1) when it exits the skin-pass rolling stand (7) are set at
the~~a~~ ratio ($1-E^*$) of the desired thickness of the metal strip (1) when it exits the skin-pass
rolling stand (7) to the thickness of the metal strip (1) when it enters the skin-pass rolling
stand (7).

6. The method ~~as claimed in~~according to claim 1, 2, 3, 4 or 5, characterized
in that further comprising correcting the set value ($v^*(1-E^*)$) for the velocity (v_i) of the
metal strip (1) when it enters the skin-pass rolling stand (7) is ~~corrected~~ as a function of a
measured value ($v_{i,m}$) for the velocity (v_i) of the metal strip (1) when it enters the skin-

NY02:365637.1
COMPARISON

pass rolling stand (7) and of a measured value ($v_{o,m}$) for the velocity (v_o) of the metal strip (1) when it exits the skin-pass rolling stand (7).

7. The method as ~~claimed in~~ according to claim 1, 2, 3, 4, 5 or 6, characterized in that ~~that~~ further comprising correcting the set value ($v^*(1-E^*)$) for the velocity (v_i) of the metal strip (1) when it enters the skin-pass rolling stand (7) is ~~corrected~~ as a function of a temporal mean (θ) of measured values ($v_{i,m}$) for the velocity (v_i) of the metal strip (1) when it enters the skin-pass rolling stand (7) and of a temporal mean ~~(of measured values for the velocity of the metal strip)~~ of measured values ($v_{o,m}$) for the velocity (v_o) of the metal strip (1) ~~when it exits the skin-pass rolling stand (7).~~ of measured values ($v_{o,m}$) for the velocity (v_o) of the metal strip (1) when it exits the skin-pass rolling stand (7).

8. The method as ~~claimed in~~ according to claim 1, 2, 3, 4, 5, 6 or 7, characterized in that ~~the~~ further comprising setting a roll nip in the skin-pass rolling stand (7) is set as a function of the tension in the metal strip (1) upstream of the skin-pass rolling stand (7) and as a function of the tension in the metal strip (1) downstream of the skin-pass rolling stand (7).

9. A ~~device~~ skin-pass rolling stand for use in rolling a metal strip (1) using a skin-pass rolling stand (7) in accordance with the method ~~as of~~ as claimed in one of the preceding claims, the thickness of the metal strip (1) being reduced by the rolling in the skin-pass rolling stand (7), characterized in that ~~the device for rolling the metal strip (1) has~~ comprising a means for setting the strip entry velocity, for the purpose of setting the velocity (v_i) of the metal strip (1) when it enters the skin-pass rolling stand (7)

NY02:365637.1

independently of the tension in the metal strip (1), and a means for setting the strip exit velocity, ~~for the purpose of setting the velocity (v_e) of the metal strip (1) when it exits the skin-pass rolling stand (7) independently of the tension in the metal strip (1).~~

ABSTRACT OF THE DISCLOSURE

Method and device for rolling a metal strip by means of a skin-pass rolling stand (7), the thickness of the metal strip (1) being reduced by the rolling in the skin-pass rolling stand (7), and the velocity of the metal strip (1) when it enters the skin-pass rolling stand (7) and the velocity of the metal strip (1) when it exits the skin-pass rolling stand (7) being set independently of the tension in the metal strip (1).

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TO ALL WHOM IT MAY CONCERN:

Be it known that WE, HANS-JOACHIM-FELKL, JOACHIM GÖEPEL, and ROBERT WINKLER, citizens of Germany, Germany, and Austria, respectively, whose post office addresses are Dreifaltigkeitsweg 8, D-91301 Forchheim, Germany; Fichtenstrasse 18, D-91094 Langensendelbach, Germany; and Donato-Polli-Strasse 54, D-91056 Erlangen, Germany, respectively, have invented an improvement in:

METHOD AND DEVICE FOR ROLLING A METAL STRIP
BY MEANS OF A SKIN-PASS ROLLING STAND

of which the following is a

SPECIFICATION

BACKGROUND OF THE INVENTION

[0001] The invention relates to a method and a device for rolling a metal strip by means of a skin-pass rolling stand, the thickness of the metal strip being reduced by the rolling in the skin-pass rolling stand. The skin-pass rolling of steel by means of a skin-pass rolling stand serves primarily to roll specific properties into the steel by means of a slight reduction in thickness. In particular, flat products produced from soft steels for cold-working in accordance with DIN EN 10130 and DIN EN 10131, hot-rolled metal strip in accordance with DIN EN 10051, precursor material for electrolytic strip surface treatment (DIN 17163-electrolytically galvanized, cold-rolled strip and sheet), relatively high-strength steels and phosphorus-alloyed steels with and without bake-hardening

effects in accordance with SEW 093 and SEW 094, soft microalloyed steels in accordance with SEW 095, galvanized strip (in accordance with DIN EN 10142), electric sheet produced from unalloyed and alloyed steels, non-grain-oriented, non-final-annealed in accordance with DIN 46400 Parts 2 and 4 and cold-rolled broad strip made from stainless, heat-resistant steels in accordance with DIN 59381 and 59382 are suitable for the skin-pass rolling.

[0002] The skin-pass rolling of soft steels (steel strips) for cold-working is carried out in particular with the aim of eliminating the pronounced yield point of the steel strip, improving the planarity of the steel strip and setting a defined roughness of the strip surface.

[0003] It is an object of the invention to further improve the quality parameters of steels or steel strips, such as for example the yield strength, the planarity or the roughness of the steel strip, by means of skin-pass rolling.

[0004] According to the invention, the object is achieved by means of a method or a device for rolling a metal strip by means of a skin-pass rolling stand in accordance with claim 1 or claim 9, respectively. The thickness of the metal strip is reduced by rolling in the skin-pass rolling stand, the velocity of the metal strip when it enters the skin-pass rolling stand and the velocity of the metal strip when it exits the skin-pass rolling stand being set independently of the tension in the metal strip. In this way, it is possible to set the desired reduction in thickness particularly accurately, so that metal or steel strip of particularly high quality is formed. This method according to the invention is so accurate that it is even possible to reduce the yield strength in a steel in which a significant

reduction of the yield strength is only possible when the thickness is reduced by an amount which lies within a very narrow range, for example between 0.475 and 0.525%. Accordingly, the invention is particularly advantageously used for metal strips whose thickness is reduced by between 0.1% and 5%, advantageously between 0.1% and 1%.

[0005] In an advantageous configuration of the invention, the velocity of the metal strip when it enters the skin-pass rolling stand and the velocity of the metal strip when it exits the skin-pass rolling stand are set with the ratio of the desired thickness of the metal strip when it exits the skin-pass rolling stand to the thickness of the metal strip when it enters the skin-pass rolling stand. The reduction in thickness is usually given as the lengthening of the metal strip or the elongation ratio, i.e. in an advantageous configuration of the invention the velocity of the metal strip when it enters the skin-pass rolling stand and the velocity of the metal strip when it exits the skin-pass rolling stand are set with the ratio of the length of the metal strip when it enters the skin-pass rolling stand to the desired length of the metal strip when it exits the skin-pass rolling stand.

[0006] In a further advantageous configuration of the invention, a means for setting the strip entry velocity is provided for the purpose of setting the velocity of the metal strip when it enters the skin-pass rolling stand, and a means for setting the strip exit velocity is provided for the purpose of setting the velocity of the metal strip when it exits the skin-pass rolling stand, and a controller is provided for controlling the means for setting the strip entry velocity, and a controller is provided for controlling the means for setting the strip exit velocity, a set value for the velocity of the metal strip when it enters the skin-pass rolling stand being fed to the controller of the means for setting the strip entry

velocity and a set value for the velocity of the metal strip when it exits the skin-pass rolling stand being fed to the controller of the means for setting the strip exit velocity, and in which the set value for the velocity of the metal strip when it enters the skin-pass rolling stand and the set value for the velocity of the metal strip when it exits the skin-pass rolling stand are set at the ratio of the desired thickness of the metal strip when it exits the skin-pass rolling stand to the thickness of the metal strip when it enters the skin-pass rolling stand. The same effect is achieved by setting the set value for the velocity of the metal strip when it enters the skin-pass rolling stand and the set value for the velocity of the metal strip when it exits the skin-pass rolling stand with the ratio of the length of the metal strip when it enters the skin-pass rolling stand to the desired length of the metal strip when it exits the skin-pass rolling stand.

[0007] In a further advantageous configuration of the invention, the set value for the velocity of the metal strip when it enters the skin-pass rolling stand is corrected as a function of a measured value for the velocity of the metal strip when it enters the skin-pass rolling stand and of a measured value for the velocity of the metal strip when it exits the skin-pass rolling stand.

[0008] In a further advantageous configuration of the invention, the set value for the velocity of the metal strip when it enters the skin-pass rolling stand is corrected as a function of a temporal mean of measured values for the velocity of the metal strip when it enters the skin-pass rolling stand and of a temporal mean of measured values for the velocity of the metal strip when it exits the skin-pass rolling stand.

[0009] In a particularly advantageous configuration of the invention, the roll nip in the skin-pass rolling stand is set as a function of the tension in the metal strip upstream of the skin-pass rolling stand and as a function of the tension in the metal strip downstream of the skin-pass rolling stand.

[0010] Further advantages and inventive details will emerge from the following description of exemplary embodiments. In the drawing:

FIG. 1 shows a known control arrangement for a skin-pass rolling stand,

FIG. 2 shows an exemplary embodiment of an inventive control arrangement for a skin-pass rolling stand,

FIG. 3 shows a particularly advantageous exemplary embodiment for a control arrangement for a skin-pass rolling stand.

[0011] FIG. 1 shows a known control arrangement for a skin-pass rolling stand 7 for the skin-pass rolling of a metal strip 1. The skin-pass rolling stand 7 has two working rollers 10 and 11 and two support rollers 8 and 9. The metal strip 1 passes through the skin-pass rolling stand 7 in the direction indicated by arrow 6. A means for setting the strip entry velocity, indicated by the rolls 2 and 3, is provided upstream of the skin-pass rolling stand 7. A means for setting the strip exit velocity, indicated by the rolls 4 and 5, is provided downstream of the skin-pass rolling stand 7. In the present exemplary embodiment, the means for setting the strip entry velocity and the means for setting the strip exit velocity are designed as a bridle. However, they may also be designed as levelers, S-rolls or coilers. A velocity v_i is imposed on the metal strip 1 upstream of the skin-pass rolling stand 7 by means of the rolls 2 and 3. A velocity v_o is imposed on the

metal strip 1 downstream of the skin-pass rolling stand 7 by means of the rolls 4 and 5.

To set the velocity v_o of the metal strip 1 downstream of the skin-pass rolling stand 7, a controller 21 is provided, to which a set value v^* is fed. The controller 21 controls the rolls 4 and 5 in such a manner that the velocity v_o of the metal strip 1 when it exits the skin-pass rolling stand 7 corresponds to a desired set velocity v^* .

[0012] Tension-measuring rolls 12 and 13, which measure the tension τ_i of the metal strip 1 upstream of the skin-pass rolling stand 7 and the tension τ_o in the metal strip 1 downstream of the skin-pass rolling stand 7, are provided upstream and downstream of the skin-pass rolling stand 7. The values τ_i and τ_o , together with their corresponding predetermined set values τ_i^* and τ_o^* and also a set value v_w^* for the velocity v_w of the skin-pass rolling stand 7, are input variables for a tension controller 14. The tension controller 14 controls the velocity v_w of the skin-pass rolling stand 7. In addition, the tension controller 14 emits a tension-dependent correction value k_τ .

[0013] Moreover, in an exemplary configuration of the invention, the tension-measuring rolls 12 and 13 have incremental sensors (not shown), which measure the rotation of the tension-measuring rolls 12 and 13. These measured values are used to form a strip-lengthening value e , to which the following relationship applies:

$$e = \frac{v_{o,m} - v_{i,m}}{v_{i,m}}$$

where $v_{o,m}$ is the velocity of the metal strip 1 downstream of the skin-pass rolling stand 7 measured by the incremental sensor of the tension-measuring roll 13, and $v_{i,m}$ is the velocity of the metal strip 1 upstream of the skin-pass rolling stand 7 measured by means

of the incremental sensor of the tension-measuring roll 12. A value $v^*(1-e)$, which has previously been added to the tension correction value k_t , is fed to the controller 20 as set value for the velocity.

[0014] Moreover, there is provision for the rolling force in the skin-pass rolling stand 7 to be set to a predetermined set value F_w^* by means of a controller 15.

[0015] For reasons of clarity, the feedback means for the controllers 15, 20 and 21 are not illustrated.

[0016] FIG. 2 shows an exemplary configuration of the invention, in which the velocity v_i of the metal strip 1 when it enters the skin-pass rolling stand 7 is set independently of the tension in the metal strip 1. In a particularly advantageous configuration of the invention, the velocity v_i of the metal strip 1 when it enters the skin-pass rolling stand 7 is set to a set value $v^*(1-E^*)$. In this case, E^* is the set value for the elongation e of metal strip 1.

[0017] Instead of the tension controller 14 shown in FIG. 1, a tension-monitoring means 22 is provided. The tension-monitoring means – which is advantageously designed as a tension controller with preceding dead band – emits an additional set value dF_w for the rolling force, instead of a tension-specific correction value k_t , when the strip tension reaches the limit of its regulating range. The rolling force in this case remains as constant as possible.

[0018] FIG. 3 shows an advantageous exemplary configuration of the invention. In this figure, the exemplary embodiment shown in FIG. 2 has been supplemented with a

thickness-correction controller 25. The thickness-correction controller 25 determines a correction value k_E which is fed to the controller 20 and by means of which, for example, the set value $v^*(1-E^*)$ is corrected.

[0019] The thickness controller 25 determines the correction value k_E in such a manner that the temporal mean \bar{e} of the strip-elongation value e corresponds to one of the set values of the thickness reduction E^* . The temporal mean \bar{e} of the strip-elongation value e is formed by means of the functional block 26 in accordance with

$$\bar{e} = \frac{\bar{v}_{o,m} - \bar{v}_{i,m}}{\bar{v}_{i,m}}$$

where $\bar{v}_{o,m}$ is the temporal mean of the value $v_{o,m}$, i.e. the temporal mean of the velocity of the metal strip 1 downstream of the skin-pass rolling stand 7 measured by the incremental sensor of the tension-measuring roll 13, and $\bar{v}_{i,m}$ is the temporal mean of the value $v_{i,m}$, i.e. the temporal mean of the velocity of the metal strip 1 upstream of the skin-pass rolling stand 7 measured by the incremental sensor of the tension-measuring roll 13. The devices for forming mean values 27 and 28 are provided for the purpose of forming $\bar{v}_{o,m}$ and $\bar{v}_{i,m}$.

WE CLAIM:

1. A method for rolling a metal strip (1) by means of a skin-pass rolling stand (7), the thickness of the metal strip (1) being reduced by the rolling in the skin-pass rolling stand (7), characterized in that the velocity (v_i) of the metal strip (1) when it enters the skin-pass rolling stand (7) and the velocity (v_o) of the metal strip (1) when it exits the skin-pass rolling stand (7) are set independently of the tension in the metal strip (1).
2. The method as claimed in claim 1, characterized in that the thickness of the metal strip (1) is reduced by between 0.1% and 5%.
3. The method as claimed in claim 2, characterized in that the thickness of the metal strip (1) is reduced by between 0.1% and 1%.
4. The method as claimed in claim 1, 2 or 3, characterized in that the velocity (v_i) of the metal strip (1) when it enters the skin-pass rolling stand (7) and the velocity (v_o) of the metal strip (1) when it exits the skin-pass rolling stand (7) are set with the ratio $(1-E^*)$ of the desired thickness of the metal strip (1) when it exits the skin-pass rolling stand (7) to the thickness of the metal strip (1) when it enters the skin-pass rolling stand (7).
5. The method as claimed in claim 1, 2, 3 or 4, in which a means for setting the strip entry velocity is provided for the purpose of setting the velocity (v_i) of the metal strip (1) when it enters the skin-pass rolling stand (7), and a means for setting the strip exit velocity is provided for the purpose of setting the velocity (v_o) of the metal strip (1) when it exits the skin-pass rolling stand (7), and a controller (20) is provided for controlling the means for setting the strip entry velocity, and a controller (21) is provided

for controlling the means for setting the strip exit velocity, a set value for the velocity (v_i) of the metal strip (1) when it enters the skin-pass rolling stand (7) being fed to the controller (20) of the means for setting the strip entry velocity and a set value for the velocity (v_o) of the metal strip (1) when it exits the skin-pass rolling stand (7) being fed to the controller (21) of the means for setting the strip exit velocity, characterized in that the set value ($v^*(1-E^*)$) for the velocity (v_i) of the metal strip (1) when it enters the skin-pass rolling stand (7) and the set value (v^*) for the velocity (v_o) of the metal strip (1) when it exits the skin-pass rolling stand (7) are set at the ratio $(1-E^*)$ of the desired thickness of the metal strip (1) when it exits the skin-pass rolling stand (7) to the thickness of the metal strip (1) when it enters the skin-pass rolling stand (7).

6. The method as claimed in claim 1, 2, 3, 4 or 5, characterized in that the set value ($v^*(1-E^*)$) for the velocity (v_i) of the metal strip (1) when it enters the skin-pass rolling stand (7) is corrected as a function of a measured value ($v_{i,m}$) for the velocity (v_i) of the metal strip (1) when it enters the skin-pass rolling stand (7) and of a measured value ($v_{o,m}$) for the velocity (v_o) of the metal strip (1) when it exits the skin-pass rolling stand (7).

7. The method as claimed in claim 1, 2, 3, 4, 5 or 6, characterized in that the set value ($v^*(1-E^*)$) for the velocity (v_i) of the metal strip (1) when it enters the skin-pass rolling stand (7) is corrected as a function of a temporal mean ($\bar{v}_{i,m}$) of measured values ($v_{i,m}$) for the velocity (v_i) of the metal strip (1) when it enters the skin-pass rolling stand (7) and of a temporal mean ($\bar{v}_{o,m}$) of measured values ($v_{o,m}$) for the velocity (v_o) of the metal strip (1) when it exits the skin-pass rolling stand (7).

8. The method as claimed in claim 1, 2, 3, 4, 5, 6 or 7, characterized in that the roll nip in the skin-pass rolling stand (7) is set as a function of the tension in the metal strip (1) upstream of the skin-pass rolling stand (7) and as a function of the tension in the metal strip (1) downstream of the skin-pass rolling stand (7).

9. A device for rolling a metal strip (1) using a skin-pass rolling stand (7) in accordance with the method as claimed in one of the preceding claims, the thickness of the metal strip (1) being reduced by the rolling in the skin-pass rolling stand (7), characterized in that the device for rolling the metal strip (1) has a means for setting the strip entry velocity, for the purpose of setting the velocity (v_i) of the metal strip (1) when it enters the skin-pass rolling stand (7) independently of the tension in the metal strip (1), and a means for setting the strip exit velocity, for the purpose of setting the velocity (v_o) of the metal strip (1) when it exits the skin-pass rolling stand (7) independently of the tension in the metal strip (1).

ABSTRACT OF THE DISCLOSURE

Method and device for rolling a metal strip by means of a skin-pass rolling stand (7), the thickness of the metal strip (1) being reduced by the rolling in the skin-pass rolling stand (7), and the velocity of the metal strip (1) when it enters the skin-pass rolling stand (7) and the velocity of the metal strip (1) when it exits the skin-pass rolling stand (7) being set independently of the tension in the metal strip (1).

GR 99 P 3476

99 P 3476

1/3

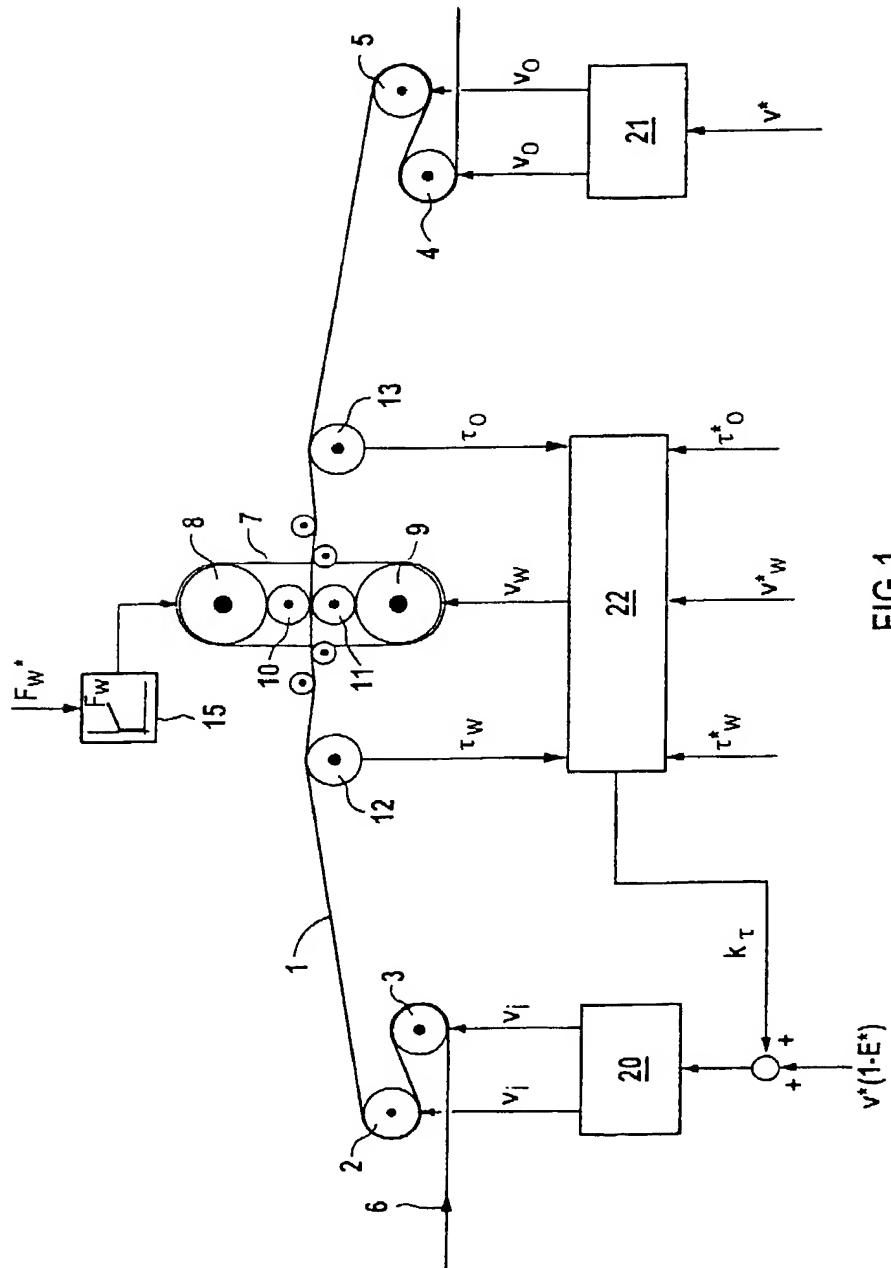


FIG 1

GR 99 P 3476

99 P 3476

2/3

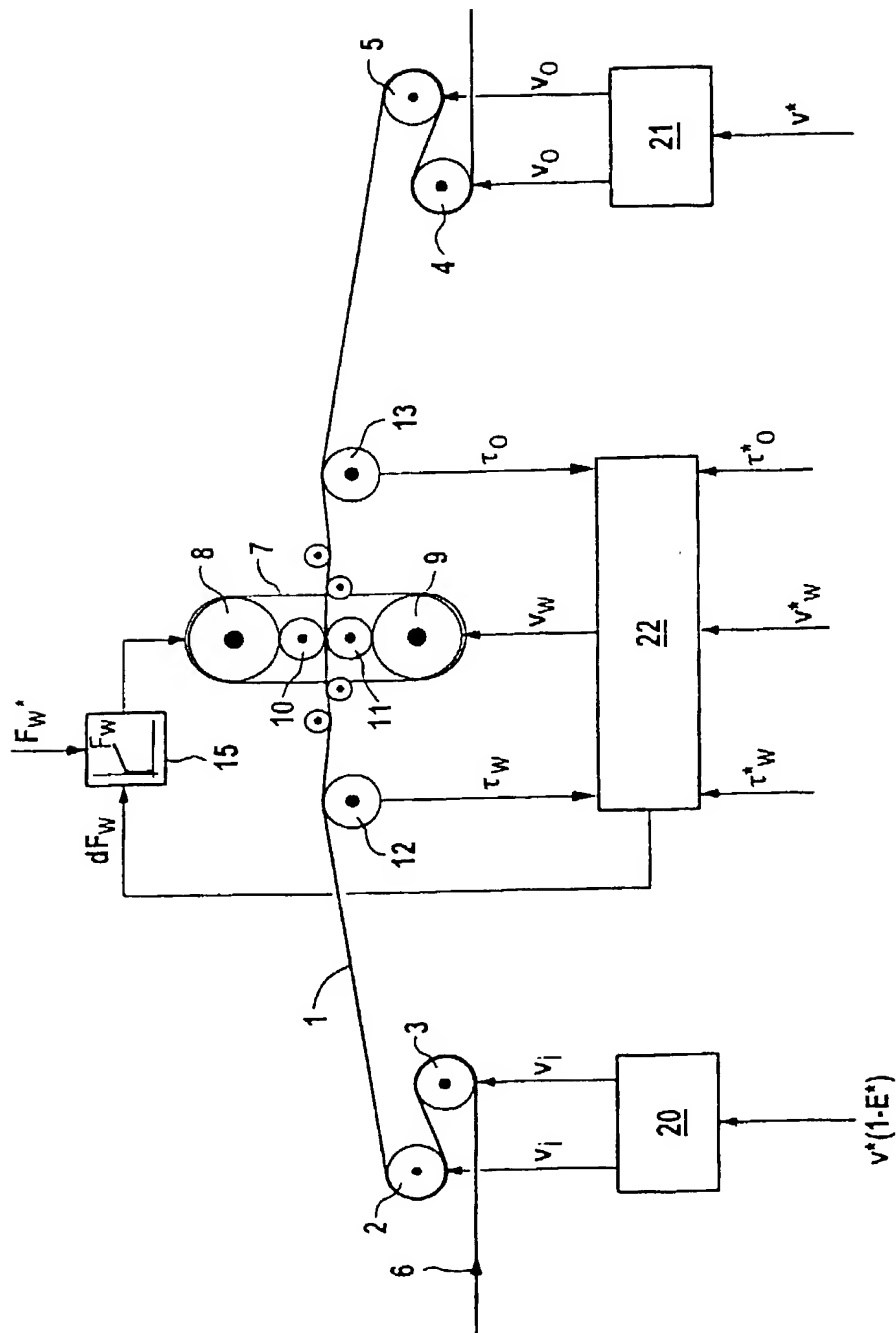


FIG 2

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99 P 3476

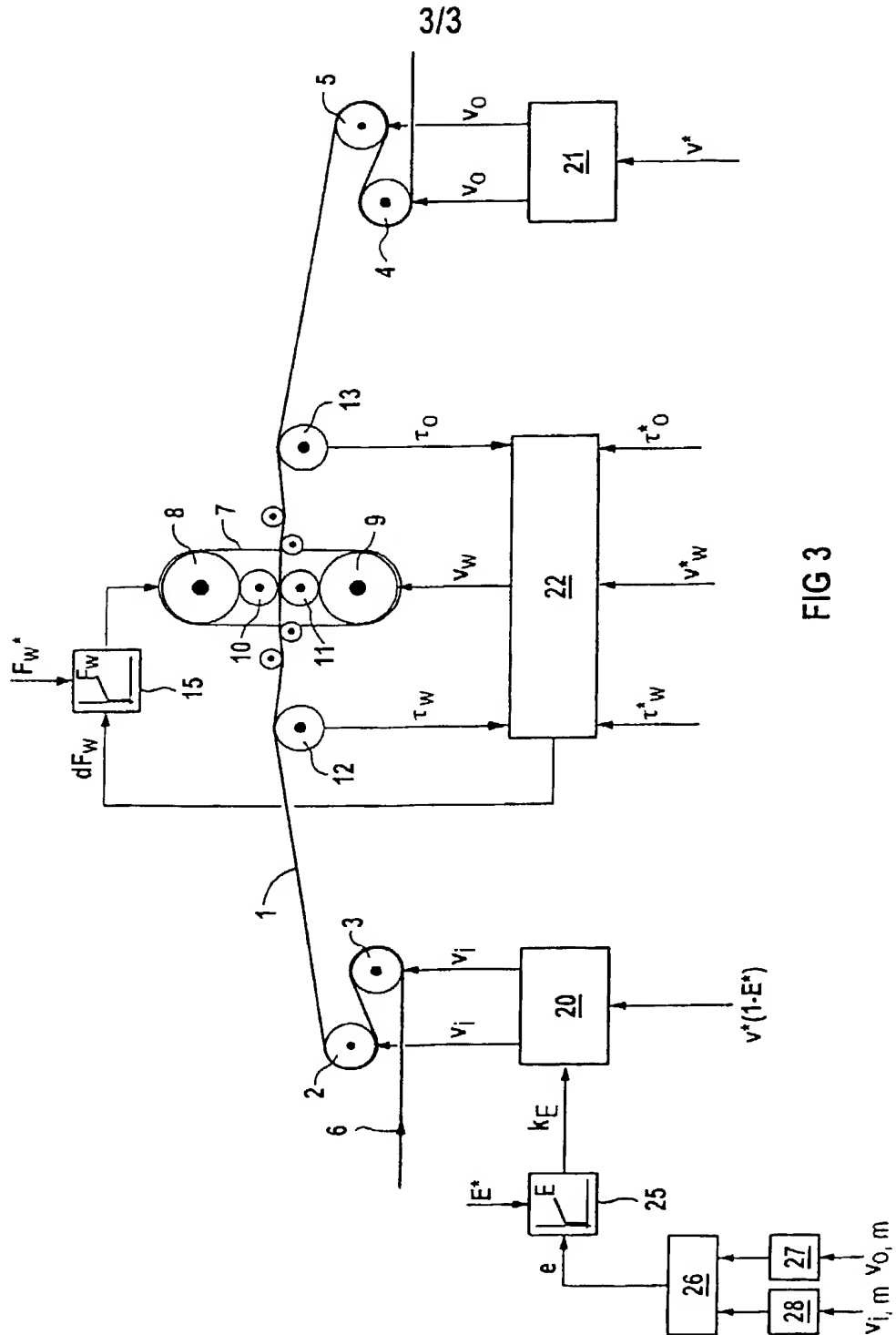


FIG 3

Declaration and Power of Attorney For Patent Application

Erklärung Für Patentanmeldungen Mit Vollmacht

German Language Declaration

Als nachstehend benannter Erfinder erkläre ich hiermit an Eides Statt:

dass mein Wohnsitz, meine Postanschrift, und meine Staatsangehörigkeit den im Nachstehenden nach meinem Namen aufgeführten Angaben entsprechen,

dass ich, nach bestem Wissen der ursprüngliche, erste und alleinige Erfinder (falls nachstehend nur ein Name angegeben ist) oder ein ursprünglicher, erster und Miterfinder (falls nachstehend mehrere Namen aufgeführt sind) des Gegenstandes bin, für den dieser Antrag gestellt wird und für den ein Patent beantragt wird für die Erfindung mit dem Titel:

Verfahren und Einrichtung zum Walzen
eines Metallbandes mittels eines
Dressiergerüsts

deren Beschreibung

(zutreffendes ankreuzen)

☐ hier beigefügt ist.

☒ am 04.07.2000 als

PCT internationale Anmeldung

PCT Anmeldungsnummer PCT/DE00/02172

eingereicht wurde und am _____
abgeändert wurde (falls tatsächlich abgeändert).

Ich bestätige hiermit, dass ich den Inhalt der obigen Patentanmeldung einschliesslich der Ansprüche durchgesehen und verstanden habe, die eventuell durch einen Zusatzantrag wie oben erwähnt abgeändert wurde.

Ich erkenne meine Pflicht zur Offenbarung irgendwelcher Informationen, die für die Prüfung der vorliegenden Anmeldung in Einklang mit Absatz 37, Bundesgesetzbuch, Paragraph 1.56(a) von Wichtigkeit sind, an.

Ich beanspruche hiermit ausländische Prioritätsvorteile gemäss Abschnitt 35 der Zivilprozessordnung der Vereinigten Staaten, Paragraph 119 aller unten angegebenen Auslandsanmeldungen für ein Patent oder eine Erfindersurkunde, und habe auch alle Auslandsanmeldungen für ein Patent oder eine Erfindersurkunde nachstehend gekennzeichnet, die ein Anmeldedatum haben, das vor dem Anmeldedatum der Anmeldung liegt, für die Priorität beansprucht wird.

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name,

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

METHOD AND DEVICE FOR ROLLING
A METAL STRIP USING A SIZING
STAND ✓

the specification of which

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☐ is attached hereto.

☒ was filed on 04.07.2000 ✓ as

PCT international application

PCT Application No. PCT/DE00/02172 ✓

and was amended on _____
(if applicable)

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

German Language Declaration

Prior foreign applications
Priorität beansprucht

Priority Claimed

19933239.8 ✓

(Number)
(Nummer)

DE ✓

(Country)
(Land)

15.07.1999 ✓

(Day Month Year Filed)
(Tag Monat Jahr eingereicht)

☒

Yes
Ja

☐

No
Nein

(Number)
(Nummer)

(Country)
(Land)

(Day Month Year Filed)
(Tag Monat Jahr eingereicht)

☐

Yes
Ja

☐

No
Nein

(Number)
(Nummer)

(Country)
(Land)

(Day Month Year Filed)
(Tag Monat Jahr eingereicht)

☐

Yes
Ja

☐

No
Nein

Ich beanspruche hiermit gemäss Absatz 35 der Zivilprozessordnung der Vereinigten Staaten, Paragraph 120, den Vorzug aller unten aufgeführten Anmeldungen und falls der Gegenstand aus jedem Anspruch dieser Anmeldung nicht in einer früheren amerikanischen Patentanmeldung laut dem ersten Paragraphen des Absatzes 35 der Zivilprozessordnung der Vereinigten Staaten, Paragraph 122 offenbart ist, erkenne ich gemäss Absatz 37, Bundesgesetzbuch, Paragraph 1.56(a) meine Pflicht zur Offenbarung von Informationen an, die zwischen dem Anmeldedatum der früheren Anmeldung und dem nationalen oder PCT internationalen Anmeldedatum dieser Anmeldung bekannt geworden sind.

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §122, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application.

PCT/DE00/02172 ✓

(Application Serial No)
(Anmeldeseriennummer)

04.07.2000

(Filing Date D, M, Y)
(Anmeldedatum T, M, J)

(Status)
(patentiert, anhängig,
aufgegeben)

pending

(Status)
(patented, pending,
abandoned)

(Application Serial No)
(Anmeldeseriennummer)

(Filing Date D,M,Y)
(Anmeldedatum T, M, J)

(Status)
(patentiert, anhängig,
aufgeben)

(Status)
(patented, pending,
abandoned)

Ich erkläre hiermit, dass alle von mir in der vorliegenden Erklärung gemachten Angaben nach meinem besten Wissen und Gewissen der vollen Wahrheit entsprechen, und dass ich diese eidesstattliche Erklärung in Kenntnis dessen abgebe, dass wissentlich und vorsätzlich falsche Angaben gemäss Paragraph 1001, Absatz 18 der Zivilprozessordnung der Vereinigten Staaten von Amerika mit Geldstrafe belegt und/oder Gefängnis bestraft werden koennen, und dass derartig wissentlich und vorsätzlich falsche Angaben die Gültigkeit der vorliegenden Patentanmeldung oder eines darauf erteilten Patentes gefährden können.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

German Language Declaration

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POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. (list name and registration number)

Customer No. 21003

And I hereby appoint

Telefongespräche bitte richten an:
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Ext. _____

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Send Correspondence to:

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30 Rockefeller Plaza 10112-0028 New York
 Telephone: (001) 212-408-25 62 and Facsimile (001) 212-705-50 20
 or
 Customer No. 21003

Voller Name des einzigen oder ursprünglichen Erfinders.		Full name of sole or first inventor	
Hans-Joachim Felki		Hans-Joachim Felki	
Unterschrift des Erfinders	Datum	Inventor's signature	Date
<i>Hans-Joachim Felki</i>	12.12.2001	<i>Hans-Joachim Felki</i>	12.12.2001
Wohnsitz		Residence	
Forchheim, DEUTSCHLAND		Forchheim, GERMANY <i>DEX</i>	
Staatsangehörigkeit		Citizenship	
DEUTSCH		GERMAN ✓	
Postanschrift		Post Office Address	
Dreifaltigkeitsweg 8		Dreifaltigkeitsweg 8	
91301 Forchheim DEUTSCHLAND		91301 Forchheim GERMANY	
Voller Name des zweiten Miterfinders (falls zutreffend)		Full name of second joint inventor, if any:	
JOACHIM GÖPEL		JOACHIM GÖPEL	
Unterschrift des Erfinders	Datum	Second inventor's signature	Date
Wohnsitz		Residence	
LANGENSENDELBACH, DEUTSCHLAND		LANGENSENDELBACH, GERMANY	
Staatsangehörigkeit		Citizenship	
DEUTSCH		GERMAN	
Postanschrift		Post Office Address	
FICHTENSTR. 18		FICHTENSTR. 18	
91094 LANGENSENDELBACH DEUTSCHLAND		91094 LANGENSENDELBACH GERMANY	

(Bitte entsprechende Informationen und Unterschriften im Falle von dritten und weiteren Miterfindern angeben).

(Supply similar information and signature for third and subsequent joint inventors).

Voller Name des dritten Miterfinders:		Full name of third joint inventor	
ROBERT WINKLER		ROBERT WINKLER	
Unterschrift des Erfinders	Datum	Inventor's signature	Date
Wohnsitz		Residence	
ERLANGEN, DEUTSCHLAND		ERLANGEN, GERMANY	
Staatsangehörigkeit		Citizenship	
ÖSTERREICH		AUSTRIAN	
Postanschrift		Post Office Address	
DONATO-POLLI-STR. 54		DONATO-POLLI-STR. 54	
91056 ERLANGEN DEUTSCHLAND		91056 ERLANGEN GERMANY	
Voller Name des vierten Miterfinders:		Full name of fourth joint inventor:	
Unterschrift des Erfinders		Inventor's signature	
Datum		Date	
Wohnsitz		Residence	
Staatsangehörigkeit		Citizenship	
Postanschrift		Post Office Address	
Voller Name des fünften Miterfinders:		Full name of fifth joint inventor:	
Unterschrift des Erfinders		Inventor's signature	
Datum		Date	
Wohnsitz		Residence	
Staatsangehörigkeit		Citizenship	
Postanschrift		Post Office Address	
Voller Name des sechsten Miterfinders:		Full name of sixth joint inventor:	
Unterschrift des Erfinders		Inventor's signature	
Datum		Date	
Wohnsitz		Residence	
Staatsangehörigkeit		Citizenship	
Postanschrift		Post Office Address	

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(Supply similar information and signature for third and subsequent joint inventors).

Declaration and Power of Attorney For Patent Application

Erklärung Für Patentanmeldungen Mit Vollmacht

German Language Declaration

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As a below named inventor, I hereby declare that:

dass mein Wohnsitz, meine Postanschrift, und meine Staatsangehörigkeit den im Nachstehenden nach meinem Namen aufgeführten Angaben entsprechen,

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I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

Verfahren und Einrichtung zum Walzen
eines Metallbandes mittels eines
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METHOD AND DEVICE FOR ROLLING
A METAL STRIP USING A SIZING
STAND

deren Beschreibung

the specification of which

(zutreffendes ankreuzen)

☐ hier beigefügt ist.

☒ am 04.07.2000 als

PCT internationale Anmeldung

PCT Anwendungsnummer PCT/DE00/02172

eingereicht wurde und am _____
abgeändert wurde (falls tatsächlich abgeändert).

(check one)

☐ is attached hereto.

☒ was filed on 04.07.2000 as

PCT international application

PCT Application No. PCT/DE00/02172

and was amended on _____
(if applicable)

Ich bestätige hiermit, dass ich den Inhalt der obigen Patentanmeldung einschliesslich der Ansprüche durchgesehen und verstanden habe, die eventuell durch einen Zusatzantrag wie oben erwähnt abgeändert wurde.

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German Language Declaration

Prior foreign applications
Priorität beansprucht

Priority Claimed

19933239.8 ✓ DE ✓
(Number) (Country)
(Nummer) (Land)

15.07.1999 ✓
(Day Month Year Filed)
(Tag Monat Jahr eingereicht)

☒ ☐
Yes No
Ja Nein

(Number) (Country)
(Nummer) (Land)

(Day Month Year Filed)
(Tag Monat Jahr eingereicht)

☐ ☐
Yes No
Ja Nein

(Number) (Country)
(Nummer) (Land)

(Day Month Year Filed)
(Tag Monat Jahr eingereicht)

☐ ☐
Yes No
Ja Nein

Ich beanspruche hiermit gemäss Absatz 35 der Zivilprozessordnung der Vereinigten Staaten, Paragraph 120, den Vorzug aller unten aufgeführten Anmeldungen und falls der Gegenstand aus jedem Anspruch dieser Anmeldung nicht in einer früheren amerikanischen Patentanmeldung laut dem ersten Paragraphen des Absatzes 35 der Zivilprozessordnung der Vereinigten Staaten, Paragraph 122 offenbart ist, erkenne ich gemäss Absatz 37, Bundesgesetzbuch, Paragraph 1.56(a) meine Pflicht zur Offenbarung von Informationen an, die zwischen dem Anmeldedatum der früheren Anmeldung und dem nationalen oder PCT internationalen Anmeldedatum dieser Anmeldung bekannt geworden sind.

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PCT/DE00/02172 ✓
(Application Serial No.)
(Anmeldeseriennummer)

04.07.2000 ✓
(Filing Date D, M, Y)
(Anmeldedatum T, M, J)

(Status)
(patentiert, anhängig,
aufgegeben)

pending
(Status)
(patented, pending,
abandoned)

(Application Serial No.)
(Anmeldeseriennummer)

(Filing Date D, M, Y)
(Anmeldedatum T, M, J)

(Status)
(patentiert, anhängig,
aufgeben)

(Status)
(patented, pending,
abandoned)

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

German Language Declaration

VERTRETUNGSVOLLMACHT: Als benannter Erfinder beauftrage ich hiermit den nachstehend benannten Patentanwalt (oder die nachstehend benannten Patentanwälte) und/oder Patent-Agenten mit der Verfolgung der vorliegenden Patentanmeldung sowie mit der Abwicklung aller damit verbundenen Geschäfte vor dem Patent- und Warenzeichenamt: (Name und Registrationsnummer anführen)

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. (list name and registration number)

Customer No. 21003

And I hereby appoint

Telefongespräche bitte richten an:
(Name und Telefonnummer)

Direct Telephone Calls to: (name and telephone number)

Ext. _____

Postanschrift:

Send Correspondence to:

Baker & Botts, L.L.P.
30 Rockefeller Plaza 10112-0028 New York
 Telephone: (001) 212-408-25 62 and Facsimile (001) 212-705-50 20
 or
Customer No. 21003

Voller Name des einzigen oder ursprünglichen Erfinders.	Full name of sole or first inventor
Hans-Joachim Felkl	Hans-Joachim Felkl
Unterschrift des Erfinders	Inventor's signature
Datum	Date
Wohnsitz	Residence
Forchheim, DEUTSCHLAND	Forchheim, GERMANY
Staatsangehörigkeit	Citizenship
DEUTSCH	GERMAN
Postanschrift	Post Office Address
Dreifaltigkeitsweg 8	Dreifaltigkeitsweg 8
91301 Forchheim	91301 Forchheim
DEUTSCHLAND	GERMANY
Voller Name des zweiten Miterfinders (falls zutreffend)	Full name of second joint inventor, if any
JOACHIM GÖPEL	JOACHIM GÖPEL
Unterschrift des Erfinders	Second inventor's signature
Datum	Date
Wohnsitz	Residence
LANGENSENDELACH, DEUTSCHLAND	LANGENSENDELACH, GERMANY
Staatsangehörigkeit	Citizenship
DEUTSCH	GERMAN
Postanschrift	Post Office Address
FICHTENSTR. 18	FICHTENSTR. 18
91094 LANGENSENDELACH	91094 LANGENSENDELACH
DEUTSCHLAND	GERMANY

(Bitte entsprechende Informationen und Unterschriften im Falle von dritten und weiteren Miterfindern angeben).

(Supply similar information and signature for third and subsequent joint inventors).

Voller Name des dritten Miterfinders ROBERT WINKLER		Full name of third joint inventor ROBERT WINKLER	
Unterschrift des Erfinders	Datum	Inventor's signature	Date
Wohnsitz ERLANGEN, DEUTSCHLAND		Residence ERLANGEN, GERMANY	
Staatsangehörigkeit ÖSTERREICH		Citizenship AUSTRIAN	
Postanschrift DONATO-POLLI-STR. 54		Post Office Address DONATO-POLLI-STR. 54	
91056 ERLANGEN		91056 ERLANGEN	
DEUTSCHLAND		GERMANY	
Voller Name des vierten Miterfinders:		Full name of fourth joint inventor:	
Unterschrift des Erfinders	Datum	Inventor's signature	Date
Wohnsitz		Residence	
Staatsangehörigkeit		Citizenship	
Postanschrift		Post Office Address	
Voller Name des fünften Miterfinders:		Full name of fifth joint inventor:	
Unterschrift des Erfinders	Datum	Inventor's signature	Date
Wohnsitz		Residence	
Staatsangehörigkeit		Citizenship	
Postanschrift		Post Office Address	
Voller Name des sechsten Miterfinders:		Full name of sixth joint inventor:	
Unterschrift des Erfinders	Datum	Inventor's signature	Date
Wohnsitz		Residence	
Staatsangehörigkeit		Citizenship	
Postanschrift		Post Office Address	

(Bitte entsprechende Informationen und Unterschriften im Falle von dritten und weiteren Miterfindern angeben).

(Supply similar information and signature for third and subsequent joint inventors).

Declaration and Power of Attorney For Patent Application

Erklärung Für Patentanmeldungen Mit Vollmacht

German Language Declaration

Als nachstehend benannter Erfinder erkläre ich hiermit an Eides Statt:

As a below named inventor, I hereby declare that:

dass mein Wohnsitz, meine Postanschrift, und meine Staatsangehörigkeit den im Nachstehenden nach meinem Namen aufgeführten Angaben entsprechen,

My residence, post office address and citizenship are as stated below next to my name,

dass ich, nach bestem Wissen der ursprüngliche, erste und alleinige Erfinder (falls nachstehend nur ein Name angegeben ist) oder ein ursprünglicher, erster und Miterfinder (falls nachstehend mehrere Namen aufgeführt sind) des Gegenstandes bin, für den dieser Antrag gestellt wird und für den ein Patent beantragt wird für die Erfindung mit dem Titel:

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

Verfahren und Einrichtung zum Walzen
eines Metallbandes mittels eines
Dressiergerüsts

METHOD AND DEVICE FOR ROLLING
A METAL STRIP USING A SIZING
STAND

deren Beschreibung

the specification of which

(zutreffendes ankreuzen)

☐ hier beigefügt ist.

☒ am 04.07.2000 als

PCT internationale Anmeldung

PCT Anwendungsnummer PCT/DE00/02172

eingereicht wurde und am

abgeändert wurde (falls tatsächlich abgeändert).

(check one)

☐ is attached hereto.

☒ was filed on 04.07.2000 ✓ as

PCT international application

PCT Application No. PCT/DE00/02172 ✓

and was amended on _____
(if applicable)

Ich bestätige hiermit, dass ich den Inhalt der obigen Patentanmeldung einschliesslich der Ansprüche durchgesehen und verstanden habe, die eventuell durch einen Zusatzantrag wie oben erwähnt abgeändert wurde.

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims as amended by any amendment referred to above.

Ich erkenne meine Pflicht zur Offenbarung irgendwelcher Informationen, die für die Prüfung der vorliegenden Anmeldung in Einklang mit Absatz 37, Bundesgesetzbuch, Paragraph 1.56(a) von Wichtigkeit sind, an.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

Ich beanspruche hiermit ausländische Prioritätsvorteile gemäss Abschnitt 35 der Zivilprozessordnung der Vereinigten Staaten, Paragraph 119 aller unten angegebenen Auslandsanmeldungen für ein Patent oder eine Erfindersurkunde, und habe auch alle Auslandsanmeldungen für ein Patent oder eine Erfindersurkunde nachstehend gekennzeichnet, die ein Anmeldedatum haben, das vor dem Anmeldedatum der Anmeldung liegt, für die Priorität beansprucht wird.

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

German Language Declaration

Prior foreign applications
Priorität beansprucht

Priority Claimed

19933239.8 ✓
(Number)
(Nummer)

DE
(Country)
(Land)

15.07.1999
(Day Month Year Filed)
(Tag Monat Jahr eingereicht)

☒ ☐
Yes No
Ja Nein

(Number) (Country)
(Nummer) (Land)

(Day Month Year Filed)
(Tag Monat Jahr eingereicht)

☐ ☐
Yes No
Ja Nein

(Number) (Country)
(Nummer) (Land)

(Day Month Year Filed)
(Tag Monat Jahr eingereicht)

☐ ☐
Yes No
Ja Nein

Ich beanspruche hiermit gemäss Absatz 35 der Zivilprozessordnung der Vereinigten Staaten, Paragraph 120, den Vorzug aller unten aufgeführten Anmeldungen und falls der Gegenstand aus jedem Anspruch dieser Anmeldung nicht in einer früheren amerikanischen Patentanmeldung laut dem ersten Paragraphen des Absatzes 35 der Zivilprozessordnung der Vereinigten Staaten, Paragraph 122 offenbart ist, erkenne ich gemäss Absatz 37, Bundesgesetzbuch, Paragraph 1.56(a) meine Pflicht zur Offenbarung von Informationen an, die zwischen dem Anmeldedatum der früheren Anmeldung und dem nationalen oder PCT internationalen Anmeldedatum dieser Anmeldung bekannt geworden sind.

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §122, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application.

PCT/DE00/02172 ✓
(Application Serial No.)
(Anmeldeseriennummer)

04.07.2000 ✓
(Filing Date D, M, Y)
(Anmeldedatum T, M, J)

(Status)
(patentiert, anhängig,
aufgegeben)

pending
(Status)
(patented, pending,
abandoned)

(Application Serial No.)
(Anmeldeseriennummer)

(Filing Date D, M, Y)
(Anmeldedatum T, M, J)

(Status)
(patentiert, anhängig,
aufgeben)

(Status)
(patented, pending,
abandoned)

Ich erkläre hiermit, dass alle von mir in der vorliegenden Erklärung gemachten Angaben nach meinem besten Wissen und Gewissen der vollen Wahrheit entsprechen, und dass ich diese eidesstattliche Erklärung in Kenntnis dessen abgebe, dass wissentlich und vorsätzlich falsche Angaben gemäss Paragraph 1001, Absatz 18 der Zivilprozessordnung der Vereinigten Staaten von Amerika mit Geldstrafe belegt und/oder Gefängnis bestraft werden können, und dass derartig wissentlich und vorsätzlich falsche Angaben die Gültigkeit der vorliegenden Patentanmeldung oder eines darauf erteilten Patentes gefährden können.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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And I hereby appoint

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(Name und Telefonnummer)

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Send Correspondence to:

Baker & Botts, L.L.P.
30 Rockefeller Plaza 10112-0028 New York
 Telephone: (001) 212-408-25 62 and Facsimile (001) 212-705-50 20
 or
Customer No. 21003

Voller Name des einzigen oder ursprünglichen Erfinders		Full name of sole or first inventor	
Hans-Joachim Felkl		Hans-Joachim Felkl	
Unterschrift des Erfinders	Datum	Inventor's signature	Date
Wohnsitz		Residence	
Forchheim, DEUTSCHLAND		Forchheim, GERMANY	
Staatsangehörigkeit		Citizenship	
DEUTSCH		GERMAN	
Postanschrift		Post Office Address	
Dreifaltigkeitsweg 8		Dreifaltigkeitsweg 8	
91301 Forchheim		91301 Forchheim	
DEUTSCHLAND		GERMANY	
Voller Name des zweiten Miterfinders (falls zutreffend)		Full name of second joint inventor, if any	
JOACHIM GÖPEL		JOACHIM GÖPEL	
Unterschrift des Erfinders	Datum	Second Inventor's signature	Date
Wohnsitz		Residence	
LANGENSENDELBACH, DEUTSCHLAND		LANGENSENDELBACH, GERMANY	
Staatsangehörigkeit		Citizenship	
DEUTSCH		GERMAN	
Postanschrift		Post Office Address	
FICHTENSTR. 18		FICHTENSTR. 18	
91094 LANGENSENDELBACH		91094 LANGENSENDELBACH	
DEUTSCHLAND		GERMANY	

(Bitte entsprechende Informationen und Unterschriften im Falle von dritten und weiteren Miterfindern angeben).

(Supply similar information and signature for third and subsequent joint inventors).

Voller Name des dritten Miterfinders		Full name of third joint inventor	
ROBERT WINKLER		ROBERT WINKLER	
Unterschrift des Erfinders	Datum	Inventor's signature	Date
		<i>Robert Winkler</i>	20.12.2001
Wohnsitz		Residence	
ERLANGEN, DEUTSCHLAND		ERLANGEN, GERMANY <i>DEX</i>	
Staatsangehörigkeit		Citizenship	
ÖSTERREICH		AUSTRIAN	
Postanschrift		Post Office Address	
DONATO-POLLI-STR. 54		DONATO-POLLI-STR. 54	
91056 ERLANGEN DEUTSCHLAND		91056 ERLANGEN GERMANY	
Voller Name des vierten Miterfinders		Full name of fourth joint inventor	
Unterschrift des Erfinders		Inventor's signature	
Datum		Date	
Wohnsitz		Residence	
Staatsangehörigkeit		Citizenship	
Postanschrift		Post Office Address	
Voller Name des fünften Miterfinders		Full name of fifth joint inventor	
Unterschrift des Erfinders		Inventor's signature	
Datum		Date	
Wohnsitz		Residence	
Staatsangehörigkeit		Citizenship	
Postanschrift		Post Office Address	
Voller Name des sechsten Miterfinders		Full name of sixth joint inventor	
Unterschrift des Erfinders		Inventor's signature	
Datum		Date	
Wohnsitz		Residence	
Staatsangehörigkeit		Citizenship	
Postanschrift		Post Office Address	

(Bitte entsprechende Informationen und Unterschriften im Falle von dritten und weiteren Miterfindern angeben).

(Supply similar information and signature for third and subsequent joint inventors).